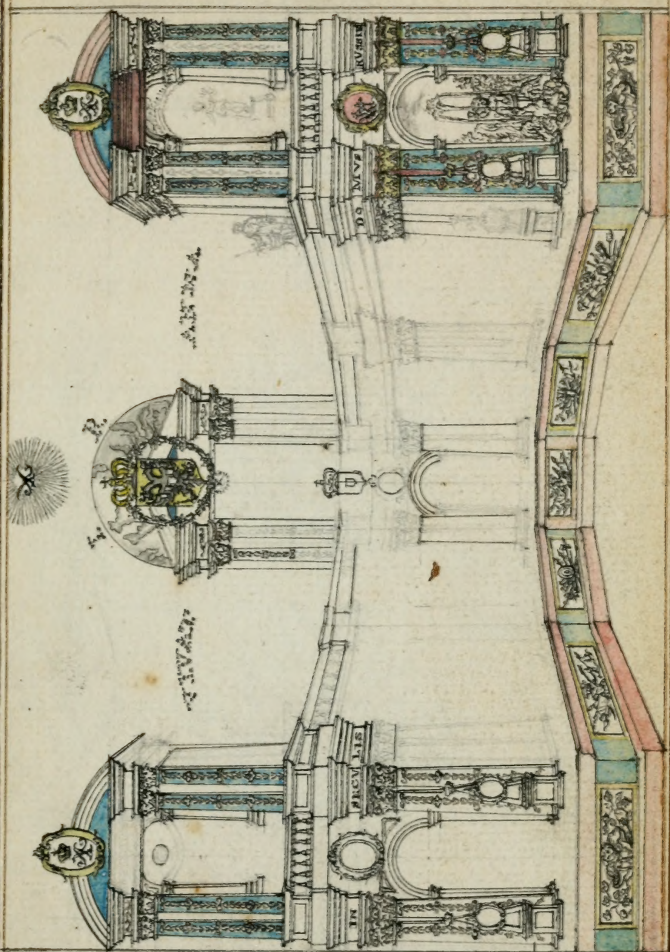


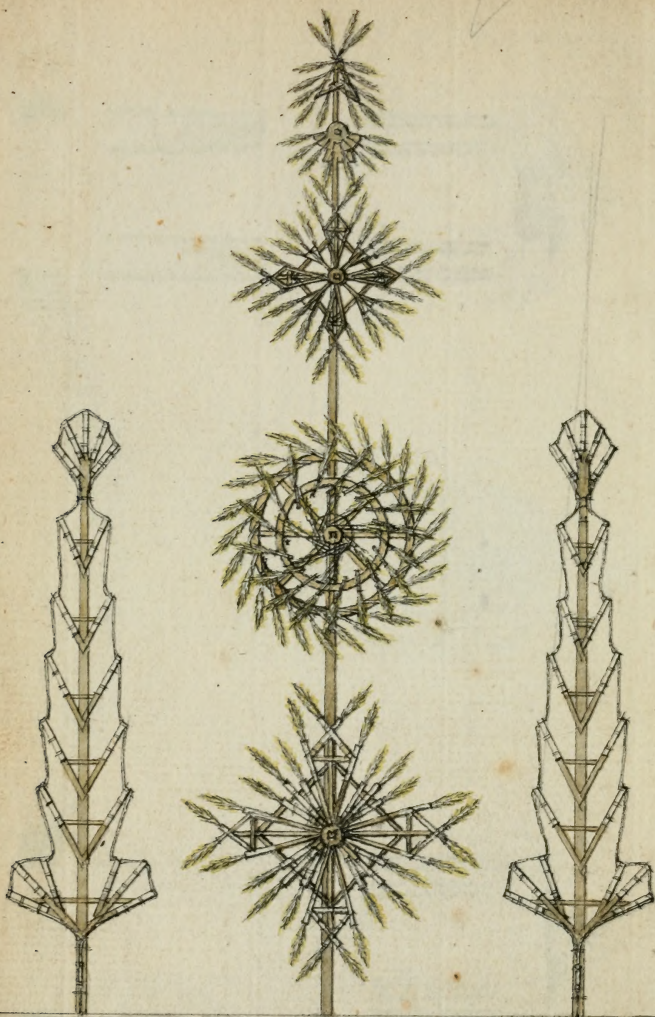
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Presented to H. C. Cramer &
by Thos. C. Cramer

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Artificial Fireworks.

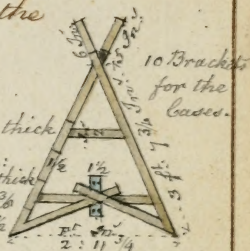
Vol: III:

1.

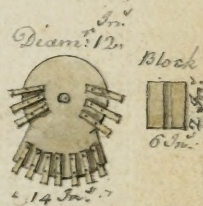
Explanation of the Frontispiece.

This Piece was called the Roman Trophies in 1774.

The upper Piece is ^{1 In.} $1\frac{1}{4}$ thick composed of fir Battens, Sides ^{1 In.} 1 thick Iron ^{6 $\frac{3}{8}$} put together according broad $1\frac{1}{2}$ to this Sketch and dimensions.



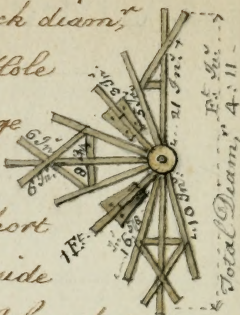
This second Piece consists of a circular sweep of fir ^{1 In.} 1 In. thick and having a label below it; behind and fixed to it is an elm Block; the hole 1 Inch diam: — the Iron ^{12 In.} long and ^{3/4} of an inch diam: — having 13 fir Brackets glued on and nailed, each Bracket ^{1 In.} 5 long, ^{3/4} broad and $\frac{1}{2}$ inch thick.



The third Piece consists of an Elm Block

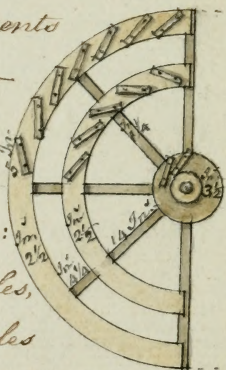
2.

Block in the Center, Block diam^r
 6 In^r by 6 In^r deep; the Hole
 1 $\frac{1}{8}$ In^r; having Four Lozenge
 Figures at Right Angles,
 and between them four short
 Arms having each two side
 Brackets; the number of brackets 28.



and 28 Cases: diam^r of the iron 1 In.
 and length 14 In^r.

This 3.^d Piece represents
 a circular Shield, com-
 posed of a Block in
 the middle, with 8
 Spokes, each Spoke 1 $\frac{1}{4}$ in.
 square - and three Circles,
 the two outward Circles
 2 $\frac{1}{2}$ in.^{In} broad, and 1 $\frac{1}{8}$ thick; the inward
 circle 3 $\frac{1}{2}$ in.^{In} broad. On the outward
 Circle are 30 Brackets for as many
 Cases; On the second Circle 20 Brackets,
 and



upper hole is $5:4$ ^{F.C. 4 In.} — from this to the
top of the Post is $4:3$ ^{F.C. 3 In.} — the upper Piece
takes up 2 feet of this length from the
top of the Post, where it is secured with
4 wood screws through the iron plate at
the middle angle below, and 2 likewise
through the cross brace at $1\frac{1}{2}$ In.

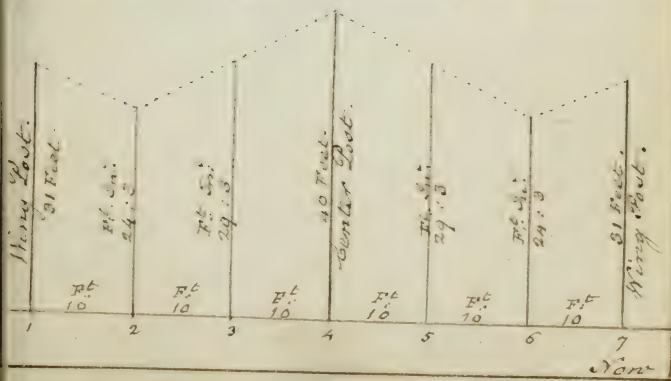
On each Side / as an Accompaniment
are 2 Bouquets, each about 21 feet high,
and fixt with 4 ounce figure cases,
each Case being 10 inches long and drove
either with Brilliant or Chinese Compos-
ition — Here the Leader's are shown
intire — for the Center Piece being
in white Fire, were the Bouquets to
be fired at the same time, the Brilliant
or Chinese would not be seen: the
Bouquets therefore must be fired after
the Center Piece. — It is usual to
fix a wood Blind in front of these Pieces
as it takes off the nakedness of the
bottom of the Posts and Framing.

5.
Floras Feast
 in Rayonnant or white Fire.

These Pieces are a Variation from the foregoing and have a fine Effect.

The 2 since Cases for them are only 6 inches long and burn about a minute and a half: these of 9 inches about $2\frac{1}{4}$ minutes.

A Reprise of these was exhibited in 1770 — by a Reprise is to be understood any regular Front of 5 or 7 Pieces of a good invention, according to the following Elevation of Lines.

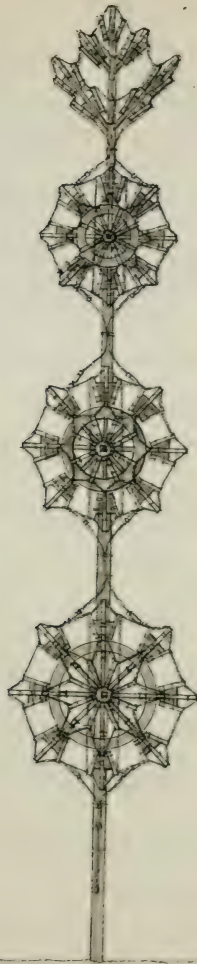


Now by the height of the Posts given, imagine the Center Post to contain 3 Pieces in Pyramids; the two second Post 2 Pieces each; the two short Posts 3 Pieces each; and the two wing Posts 4 Pieces each with their Bouquets at top.

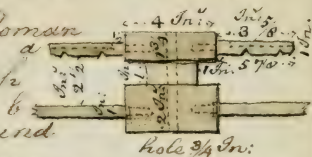
A variation of this disposition may be formed, by making the two Posts near the Center the shortest, and the two on each side, wing Posts: Or the Angle may be continued from the Center to each extreme.

But it must be judged beforehand which disposition will have the best effect.

The following Sketch represents one of the short Posts with it's Pieces and Bouquet at top; and may if thought proper be fired only as a single Piece.



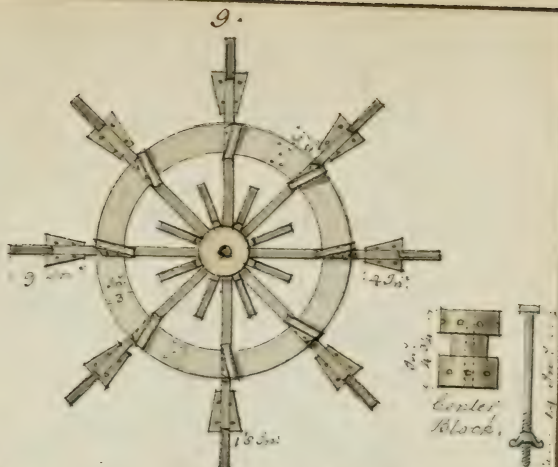
As the Blocks of these Pieces differ
 from those of the Roman
 Trophies; this Sketch
 is necessary — round



the top part of the Block are eight $\frac{3}{4}$
 inch holes at equal distances from each
 other, and round the lower part are
 eight $\frac{3}{4}$ inch holes bored so as to stand
 between the others at top, into which the
 square Spokes b, are glued; and the short
 Bracket spokes a, glued into the 8 upper
 holes.

The Iron Bolts for fixing the Pieces
 on the Post, are similar to those for
 the Roman Trophies, having square
 heads with Fluts and screws; only as
 the hole through the Blocks is $\frac{3}{4}$ of an
 inch, the diameter of these Bolts will
 be full $\frac{5}{8}$ of an inch: and length of
 each 14 inches.

The following Sketch shows one of
 the



the Pieces on a larger Scale.

This represents only the wood Work; the Center Block is Elm; the 8 short bracket spokes at top are fir 1 inch square; hollowed out about $3\frac{5}{8}$ in length and $\frac{2}{10}$ deep to receive the Cases: the 8 fir spokes behind on which the circle of fir is fixed are 1 inch square, and the Circle $\frac{3}{4}$ or 1 inch thick, on which stand 8 brackets; the 8 Short Arms are of Beech 1 inch square, the Brackets

on

on each side are fix, each being $3\frac{1}{2}$ In.^r long; 1 inch broad and depth at the head $1\frac{1}{8}$ inch.

Diameters of each Piece.

Small Piece.

	^{Fr. In.}	^{Fr. In.}		^{Fr. In.}
Diam ^r of Circle	1:6	—	Extreme	3:6.
N ^o 2. Ditto	d. ^o	—	2:0	—
Extreme	—	—	—	4:6.
N ^o 3. Ditto	d. ^o	—	2:6	—
Extreme	—	—	—	5:6.
N ^o 4. Ditto	d. ^o	—	3:0	—
Extreme	—	—	—	6:6.
N ^o 5. Largest	d. ^o	—	3:6	—
Extreme	—	—	—	7:6.

N.B. The diameter of the Circles is the extent of the Rim, but the Extreme includes the Cases.

The Form of these Pieces is all alike, except that N^o 5 and 4 have 5 Brackets on each Arm the same as for the Large Piece of the Roman Trophys.

The following Piece is here given, because the 8 Arms of the third Mutation are fixt with Rayonnant Fire.

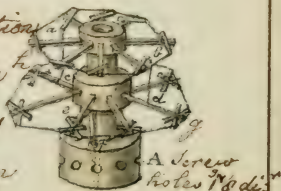
Remarks on the foregoing Regulated Piece.

The whole is fixt with 2 ounce Cases; the 1.st Mutation forming Curve Rays in strong yellow Fire — the 2.^d Mutation of Star points in Brilliant Fire — the 3.^d Mutation consisting of 8 Arms with seven Cases each, in Rayonnant Fire.


For Communicating this Piece, 3 or 4 thread Quicksnatch should be used, and the largest tube flapper Sliders.

The principal Communications are those which Lead from the 1.st Mutation to the 2.^d and from the 2.^d to the Arms, with the Seading of the Arms, as explained by the following Sketches.

Here the Communications are brought down from the ends of two opposite Cases a & b of the 1.st Mutation to the upper part of the Spokes at c & d of the 2.^d Mutation, continued and joined



joined with the circumscribing Leaders at g & h — And from the 2^d Mutation at the tail of the Case at e, and its opposite Case, the Communications are laid all along under the spoke to the sides of the middle block and put into the two holes one at f and its opposite, so that the 4 Communications stand at right angles to each other, two above and two below; the communications are secured with small larks at proper places both to the spokes and to the sides of the middle block, these Communications must be well secured with pasted double tube paper laid over them at least two or three times double and pressed very close.

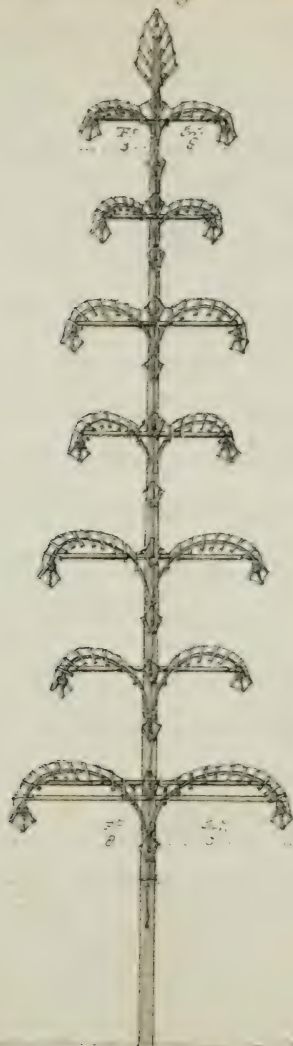
Explanation. at A in the  foregoing Sketch represents the screw holes for the Arms: this Section is to shew that by boring the holes to the Center, at all the angles of intersection the internal wood will come out, thereby forming a circular cavity all round equal to

to the size of the holes, by which means the flash from the quickmatch of the two communications is conveyed to all the 8 arms at once.



Note, that the back of the Arm is grooved all along from d to c, — and from b to c a hole bored through with a '8 inch gimblet, the Groove '70 square — all along in the groove and thro' the hole at the end of the screw lay single lengths of quickmatch, tying them gently together with fine twine; then the short tube leaders being notched in the middle and quickmatched, are to be laid on the notch downwards and secured with a tack at each side, using a small brass hammer — then all along over the groove and leaders must be secured with pasted paper treble laid on; — which being dry, the cases are to be tied on, communicated with the short leaders, and well secured with pasted paper.

Albro de Pin, in ^{15.} Rayonnant Fire.



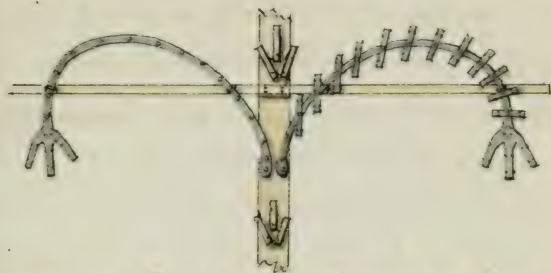
Scale Line for the Heights.

Explanation for the Albro de Pin.

This Piece consists of two parts or fir Battens, the upper length being about ^{14^{ft} 5ⁱⁿ} 10:4, on which the Bouquet at top and upper Branches are fixed; the lower length 10 feet containing the lower Branches; this Batten being about 4 inches broad at bottom tapering to 3 inches at top, and two inches thick — the Brackets of the Bouquet at top are flat, not hollowed out, to receive the Cases — the Branches are made of flattened iron about $\frac{3}{4}$ of an inch broad and $\frac{1}{10}$ thick, on which, at proper distances, are rivetted flat iron brackets $3\frac{1}{2}$ inches long and about $\frac{1}{2}$ an inch broad made of hoop iron.

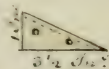
Likewise at regular intervals are fixed cross Battens about one inch broad and $\frac{3}{4}$ of an inch thick, let into the large Battens and secured with 4 wood screws each

each, these cross battens must be about 2 inches longer on each side than the extent of the Branches with the Cases.



In this sketch, one Branch has the Brackets rivetted on; the other Branch has only the rivet holes, and is only intended to show the nature of the Work, but all the Branches must be completed with their brackets before they can be fixed to the main Battin or cross pieces — to the main battin they are secured by wood screws, and to the cross pieces by wire staples in convenient places between the Brackets.

The wood Brackets on the middle Battin are angular thus.




all

All the Carpenters and Smiths work should be completed before the Cases are tied on and communicated.

To prevent References, shall beg leave to repeat the method of Leading the Cases once more



the Leaders are here represented notched to answer the vent of each Case and a length of quickmatch put through them as N^o. 1. 2.

This small Sketch is to show that the Chokes of the Cases are all to be strung with coarse twine before they are communicated from one to the other; also part of the Cases are represented as leaders with a leader notched and quickmatched ready for tying on, which is done by putting the quickmatch at the end of the leader at A, into the end of the leader at B, bringing the end of one leader over the end of the other thus  then tying down the leader to the Cases

one at a time, leaving the end open as at B before, in order to join the next leader to, after it has been measured to the heads of each Case as far as it will reach, then notched, quickmatched and tied down gently at each side of the Case, proceeding to measure, to notch, to quickmatch, and to join leader to leader, tying them down to the heads of the Cases at each side, till the whole is completely communicated.

Two ounce Cases are used for the whole of this Piece, each Case being about 6 $\frac{1}{2}$ inches long, and the Vents primed with short quickmatch in the usual manner.

Pasting. . . As the whole of this Piece takes fire at once, it is only necessary to cover once over the top of each Case, and round each Leader from case to case in the following manner, first tearing a piece off from the pasted Slip, lay it over the leader and top of the Case at A, pressing it close down



down; then lay pieces at each side of the case close up to the leader and coming upon it, press them very close, next put a piece quite round the case under and close up to the leader a little over the edge of the top of the case and press it very close every where with the fingers, taking care that not the least pinhole be left uncovered. — paste the head of the Case B exactly in the same manner, then put a piece once round the leader from A to B pressing it close: the heads of the Cases are to be pasted all over exactly in the same manner, then set to dry.

N.B. The foregoing is called single pasted, — double pasted, is going over again every part once covered — and treble pasting is covering over every part a third time — the usual mode of these two last operations, consists in first going over a part singly, and then

then going twice or thrice over that part, finishing each part as you go on, and letting the whole dry together.

Pasting is a principal Article, and though quickness is required, it ought to be well and carefully done; for which reason I have been so particular.

It is to be observed, that the length of the Slips is always the length of the half sheet of tobacco paper, which then being folded into 6 or 8 breadths as required, is to be torn into slips, which is easier, quicker, and better than being cut with a knife, taking about 6 or 8 sheets at a time.

For pasting the slips, a Board is required that will contain at least 12 of the slips; then first pasting over the Board lay the slips on single, which being pasted over, lay another slip even upon each of them, and paste all over them with the brush, which done they

they must be immediately lifted by one end off the Board, and hung over the side of a table, while fresh slips are laid down and pasted as before.

General Rules for Pasting.

• All Specchis first on Illuminations and Wheels to be pasted with single paper only once.

• All pieces which are to take fire at one time; the first fronts of regulated Pieces, and cases of Rayonnant or blue fire on Wheels, need only be covered once over with double pasted paper — For instance, this last Piece requires only once pasting because the whole is to take fire at one time; And the first front of the Regulated Piece of 3 Mutations need be only pasted once; the 2.^d. Mutation double pasted and the 8 Arms to be treble pasted.

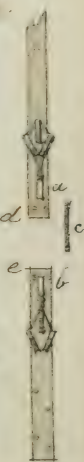
The two Communications which lead from the tails of two Cases from the
first

first Mutation to the second must be double fasted; And the two Communications, which lead from two cases of the second Mutation down into the Block to give fire to the Arms, must be treble fasted all over.

This must be understood as a full explanation of the method of fastening, both with respect to the foregoing Columns and subsequent course of this Work.

The top and bottom Branches being determined, the diameter of the rest is found by the extreme conic lines.

The middle Battinjon which the Branches are fixed being in two lengths, are to be secured on to the Post with wood screws, the ends *d, e*, close together; and then *d* the short quickmatched double leader *e*, put into the Cartridges *a & b*, and tied in, which communicates the two parts together.



Reprise of Vertical Wheels 1776.

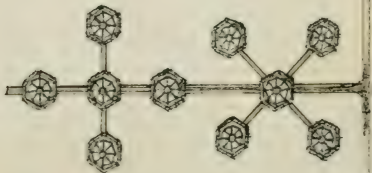
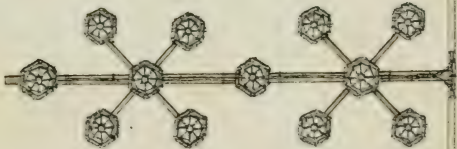
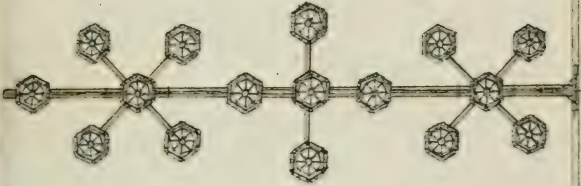
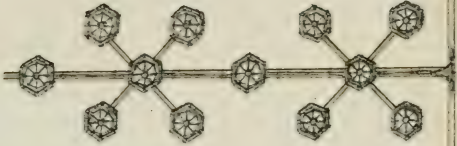
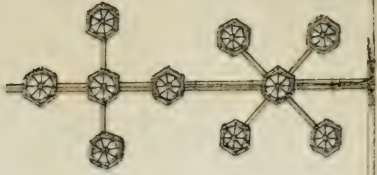
This was the last Piece invented by me for Lord Townshends Birth day being the 11.th of March above — only one of the short posts was fired upon the Green in Woolwich Warren.

As the whole of the Wheels are intended to take fire at one time, and the Communications are of the higher Order; it will be necessary to give a full Explanation thereof, in order to form a just idea for Compleating many of the ensuing Pieces.

Each Piece consists of a center Block with 4 Arms, and five Wheels, one Wheel in the center, and one upon the front end of each Arm — The Arms are $1\frac{1}{4}$ inch square, except the Screw.

On the Center Post are 3 Pieces, and one Wheel at top which goes upon the Post.

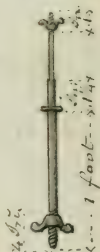
On



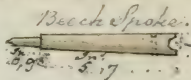
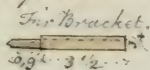
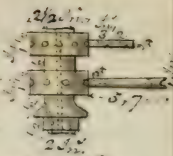
On the two second Posts, are two Pieces, and two Wheels, one between each Piece and one at top of each Post.

On the two short Posts, are only two Pieces on each.

This Sketch shows the form and dimensions of the Center Block for each Piece, being all alike — the center hole for the Iron $\frac{5}{8}$ of an inch diameter — the 4 screw holes for the Arms each 1 inch diameter — the two holes shown by dotted Lines on each side the Center are about $\frac{1}{8}$ of an inch diameter, and bored as low as the top of the screw holes — the small hole on the right between the two screw holes, and its opposite hole both bored to the Center are about $\frac{1}{4}$ of an inch in diameter — the uses of these holes will be explained further on.

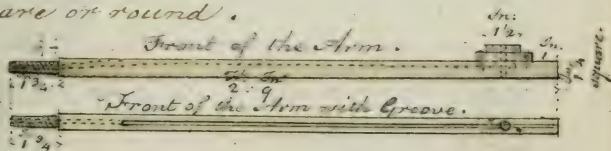


This sketch represents the Wheel Block with its dimensions, short fir Brackets & round the upper part — and 6 Beech Spokes for fixing the Wheel Case on — the Hole for the iron $\frac{3}{4}$ In. The holes both for the Brackets and Spokes are $\frac{5}{8}$ In. diameter.



The Brackets and Spokes are set into their holes with glue.

The next apparatus is the Arms which are always made of Beech, either square or round.



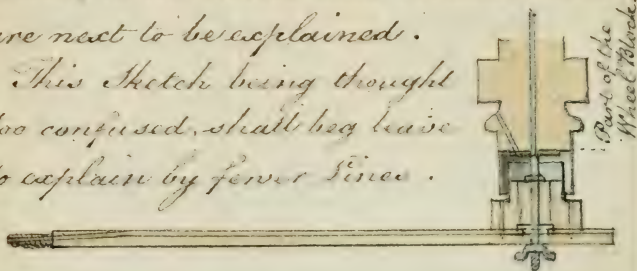
The Arms as per sketch have each a small Block fixed on them secured fast on with two wood screws.

- a, the Hole for the iron $\frac{1}{2}$ In. diam.
- b:b, two communication holes.
- c:c, the two screw holes.

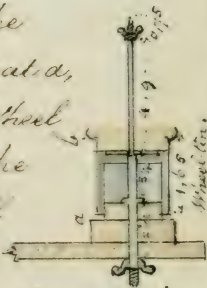


In the foregoing sketches, every thing is given, except the Irons for the Arms and their Wheels; the tin for the grand Block, arm Blocks and Wheels, which are next to be explained.

This sketch being thought too confused, shall beg leave to explain by fewer Lines.



The distance between the shoulder of the Arm Block at *a*, and the shoulder of the Wheel Block at *b*, is $1\frac{3}{4}$ in; then the depth of the Wheel tin will be 1,65 allowing 10 of an inch clear above the shoulder *a*; the depth of the tin for the arm Block will be $1\frac{3}{4}$ in; so that the Wheel may run quite clear of the tin and shoulder of the arm Block.

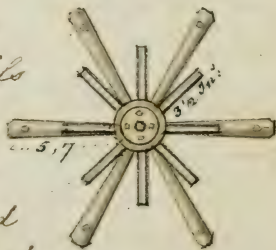


But it will be necessary that all the Arms with their blocks and irons,
and

and all the Wheels be completed; then the irons being fixed in the arms, a Wheel must be put on the spindle and the distances for the depth of the tins to be measured, and likewise for the tins and Wheels of the grand Blocks; it will also be proper to mark all the screw holes of the grand Blocks, the Arms which fit them, and likewise the Wheels, with corresponding Letters or figures cut with a Gauge or Chisel, that the whole, as first fitted, may be readily put together without mistakes.

In this Sketch the brass plate is shown fixed on with four nails upon the front of the Block; there must be a similar plate nailed on to the other end of the

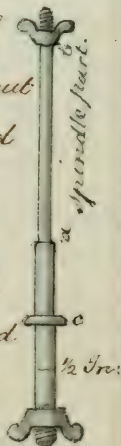
Front of the Wheel.



Block, the plates being about $\frac{1}{2}$ of an inch thick; it is upon these plates that the Wheels work with as little friction as possible.

possible, on which account the hole through the wheel Block is $\frac{1}{2}$ an inch in diameter; but the spindle part of the iron on which the wheel runs, is only $\frac{3}{8}$ inch diameter, consequently the hole through the brass plates will be only so much wider than the spindle as just to allow the wheel to turn round freely, without the least check or touching any part of the wood in the hole of the Block, and this rule holds good for all Wheels.

The spindle part from a to b, must be very straight; and about an inch below the Nut at b, and for an inch above the small shoulder at a, must be filed round and smooth; the length of the spindle should not exceed above 10 of an inch more than the whole length of the wheel Block with its brass plates, that the



Wheel

Wheel may have just sufficient play backwards and forwards but not too much — the short shoulder part next to the spindle may exceed the diameter of the spindle by about $\frac{1}{2}$ an eight of an inch more, and the edge at *a*, must be rounded off a little — the main shoulder at *c*, about $\frac{1}{10}$ of an inch thick, and $\frac{3}{4}$ of an inch diameter — but the main shoulder *c*, of the iron for the grand Blocks must be at least $\frac{1}{4}$ of an inch thick, to resist the tightness with which the Blocks require to be screwed on to the Posts.

It is also necessary to have a small brass plate on the top of each small block on all the Arms, and likewise on the top of each grand Block, for the main shoulder of the irons to bite on, in screwing them tight home.

A full Explanation is here given, as a leading principle in all similar intentions.

Supposing


Supposing then, the grand Blocks with their irons, tins and Wheels; All the Arms with their small blocks, irons, tins and Wheels, to be compleatly filled and marked — the next consideration is to furnish them with suitable Cases and Compositions.

The first Calculation is for the whole number of cases required; One Piece for instance contains 5 Wheels, — each Wheel has 8 short bracket Spokes in front, and these will require 40 short two ounce Cases, each 6 inches long, drove with Rayonnant fire —

Rayonnant Composition.	16.
Mealed Powder —————	6.
Salt Petre —————	6.
Sulphur —————	3.

The whole to be Sifted altogether 4 times through a hair Sieve, and it will be mixed for Use.

For Driving — one two ounce ladlefull of Composition at a time, and 16 strokes
with

with an 8 Inch Mallet to each ladlefull of Composition — one ladlefull of Clay to be drove at top after the Cases are drove up with composition to an equal height — The Cases being all drove and clayed, the clayed ends must be covered with pasted double tube paper, thus and being set to dry  ^{1/2 in.} for two or three days, they may be primed with Quickmatch, first with a flat brass prickler scratching the top of the Composition in each vent a little, then filling the Vents with Quickmatch stopping it in with a round pointed prickler; and then they may be tied on to the short spokes of each Wheel then the strings put round the Choke and communicated all round from Case to Case — Next, all the tyings, heads of the Cases and Leaders to be covered over with pasted double tube paper pressed close, and set to dry.

The

The next Articles are the Cases for working the Wheels, and these may be 3 Ounce frasted Cartoon Cases and 7 inches long each — 2 ounce Cases are too small and 4 ounce Cases too large.

The five Wheels at 6 Cases each, will require 30 three ounce Cases — the first thing is to stop or plug the vents with waste brown or whited brown paper — then each Case to have one ladlefull of clay drove in with 18 moderate strokes of an 8 inch Mallet and then two ladlesfull of common fire composition, with 21 strokes to each ladlefull — and thus the Cases are to be prepared for driving — and be it always remembered that all Cases first rolled and filled in Moulds are to be drove in notched

Brackets

Brackets fitted to the size of the Case; the other method of driving them on a short iron nipple is too dangerous to be relied on.

Disposition of the Cases — Each Wheel contains 6 working Cases; supposing them to be drove with three distinct Compositions — then N.^o 1 and N.^o 4 will be alike — N.^o 2 and 5 alike: N.^o 3 and 6 alike with the third Composition.

Composition 1. st	
Healed Powder	16:0.
Salt Petre	0:4.
Sulphur	0:1.

To be sifted all together four times through a hair Sieve — N.^o 1 and 4 of each Wheel to be drove with this Composition.

Composition 2. ^d	
Healed Powder	16:0.
Gold Sand	2:8.

To be sifted 4 times through a hair Sieve — N.^o 2 and 5 to be drove with this.

Composition

Composition 3.^d

lb. oz. dr.

Mealed Powder ————— 1: 4: 0.

Salt Petre ————— 0: 3: 0.

Sulphur ————— 0: 1: 0.

Filings of Steel ————— 0: 3: 8.

To be sifted all together 4 times thro' a hair sieve — N.^o 3 and 6 to be drove with this — N.B. where bright Steel or iron Filings are not handy to be got; prepared pounded Iron of a small grain may be used.

DRIVING. for each Composition, onely one Ladlesfull of Composition at a time and 21 strokes to each Ladlesfull with the 10 Inch Mallet, continuing till the cases are drove up to within half an inch of the top, to leave room for Choking — If time is short, put in two ladlesfull of Composition at a time, with 31 strokes of the Mallet to each two ladlesfull:

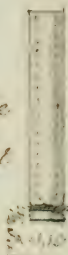
The

The general Rule, is to drive the required number of Cases with one Composition first; and so to the required number with Composition 2; and the same with Composition 3: so that if there is only one person to drive, the above method should be followed; and when there are three drivers, each one may drive the number of Cases required with the proper composition.

For instance, the five Wheels take 30 Cases — then N^o 1 and 4 for each Wheel requires 10 Cases which are to be drove with Composition 1.st — Again N^o 2 and 5 for each Wheel gives 10 Cases to be drove with Composition 2.^d — And N^o 3 and 6 for each Wheel gives 10 Cases to be drove with Composition 3.^d — 25 of the Cases after being drove, must be left open, but five of the Cases marked N^o 6 are to be drove up with Clay,
after

after they have been drove up to an equal height as the others with Composition —

3 Ounce Case per Sketch, seven inches long; exterior diameter ^{in.} 1,15; Diameter of the Bore ^{in.} 0,7: diameter of the Vent equal to $\frac{1}{3}$ of the Bore.



The Cases being drove, all the 25 must be taken to the Choking Engine and creased a little round the open ends for holding the Cartridges on.

Then the paper plugs to be picked out of the Vents, and the Cases bored with the Reamer, taking care to bore just through the Clay at the vent of each Case so as to touch the common fire, which is easily seen by a little coming out on the end of the Reamer, taking

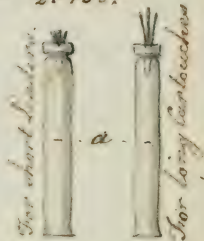


out the Reamer at times, till the composition is perceived on its end.

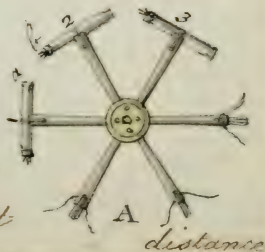
To prime the Vents of the Cases with Duickmatch — First it must be determined whether the Cases are to be communicated with short leaders or long Cartouches, because the Cases must be primed accordingly —

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But in order to know the exact distance for the length of the short leaders or Cartouches, it will be necessary to tie on two or three Cases upon a Wheel by way of trial, but first it should be observed, that the Center of all the Cases should be set off with a pair of Compasses and marked with a stroke of Ink as at a above —



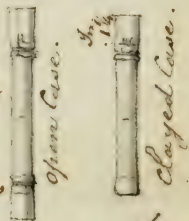
Now as per Sketch having tied on the Cases for trial, take any waste piece of Leader and measure the exact



distance from the open end of the Case at a, to the vent of the Case at b; and cut the piece of leather to that length which will be the distance of the ends of the Cases from each other for all the Wheels.

To communicate them with short Leaders — the Vents of all the Cases being properly quickmatched, all the open Cases must have a short Cartouch of tube paper rolled round and tied on with coarse twine at each end, only the 5 clayed Cases will have but one Cartouch

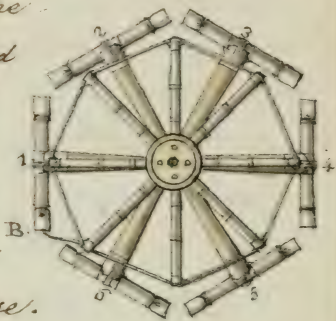
and the clayed ends covered with pasted double tube paper as per Sketch; the paper for the Cartouches must always be long enough to go three times round the Case.



Then the spokes of all the Wheels being strung with fine packthread put
three

three times through each hole, as in the foregoing sketch A, where 3 Cases are tied on, and the other 3 spokes are strung with packthread ready for tying on.

In this Sketch the Cases are represented as tied on, and all the packthreads covered over with pasted double tube paper pressed close.



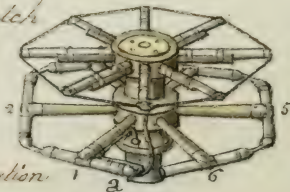
The next operation, is to place and tie in all the short Leaders which communicate from case to case, which is done by putting in the short quickmatched Leaders one at a time, and gathering the Cartouches close to the Leader tie them in with two or three turns of coarse twine, but not too hard; the Leaders being tied in, must be covered all over, and likewise the Cartouches a little beyond the choke end of each Case, with
pasted

pasted tube paper pressed very close, and then set to dry.

Each Wheel requires only 5 short leaders to communicate the working cases because N.^o 6 case is a dead head, and complicate the wheel.

At B, the head of N.^o 1 case, a short leader comes from the 2 ounce cases in front into the cartouch of N.^o 1 case, which in the sketch is left open, because the principal communication which is to give fire from the Arms to the Wheel's remains to be put in.

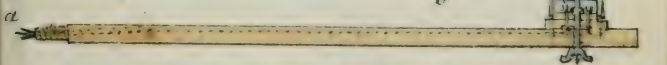
At a in this sketch is the head of N.^o 1 Case, and the



principal communication is here put in; one end of this communication goes down into a hole in the neck of the wheel block below, so that the quickmatch at that end comes into the
tin

tin cup at bottom of the wheel Block, the other end is gently bent along the spoke (to which it is tied in two places), then along the side of the case into the head cartouch of N^o 1 case, and along with it the end of the short leader which comes from the 2 ounce Cases above, both tied into the Cartouch; then all over the Cartouch, principal communication, and short Leader must be covered with pasted double tube paper, particularly securing round the hole in the neck of the block, then set to dry for a day in the shade.

Now, the Groove of the Arm, the arm block, and the principal, wheel



Communication being laid with quick-match, as here represented: If fire be given at *a*, it will run along the
Arm

arm and up the two quickmatched holes of the arm block, the flash of which, being confined by the lines, will communicate to the end of the principal Leader at bottom of the wheel, and thus will finish at the end of the principal Leader, b'.

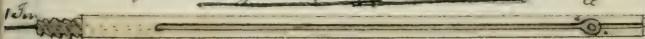
Consequently, the end b' of the principal Leader properly quick-matched, together with the end of the short Leader, from the communication of the 2 source cases, being both put into the Cartouch at the head of the Case N^o 1, the quickmatch at the end of both Leaders touching the quick-match at the vent of the case, and both Leaders tied into the cartouch, (as represented in the foregoing Sketch of the wheel complet) when the fire comes to the end b' of the principal Leader, it will communicate at the same time to the quickmatch at the vent of the Case and

and to the end of the short leader, from whence it will run to the communication all round at the head of the eight 2 ounce Cases, which all catch fire together.

Observe, that only one Wheel Case burns at a time, as being sufficient to turn the wheel, but because the whole time of Burning of the six Cases one after another, is only equal to the time of the eight 2 ounce Cases, that the whole may finish at the same time.

Next, it will be necessary to show in what manner all the Arms and Wheels take fire from the grand or center Block; but first it may be proper to explain the method of quick-matching the Arms.

Lengths of Quickmatch tied.



The hole through the screw part to the beginning of the Groove is bored first with a long small Gimblet for that purpose, and then the Arm grooved all the way to

to the end with a plane; the groove is always $\frac{1}{4}$ of an inch wide and the same in depth; at *a*, is a circular part cut out of equal depth with the groove and about $\frac{9}{10}$ of an inch in diameter, the hole in the middle is for the iron to go through, and the two small dots on each side of the hollow mark the place for the screws.

To quickmatch the Arms, is only to lay in lengths of quickmatch single, only tying them gently together end to end in two places with Dutch twine, as per foregoing sketch, the overlap about $1\frac{1}{2}$ inch, laying them carefully in the groove, and when it comes up to the hollow at *a*, the quickmatch must be carefully bent and laid all round the hollow and about half an inch back into the groove cutting off the superfluous end of quickmatch, if any.

Then take small tacks about $3\frac{1}{2}$ tenths long

long, put one at the end of the groove
next to the hollow, and one at each side
of the hollow, setting them carefully in
with a small brass hammer, taking
care not to drive them in so hard as
to cut or press too hard upon the quick
match, nor to prevent the Iron from
going through the hole, but the heads
just flush with the top of the wood,—
these tacks are only intended to keep
the quick match in its place in the
Hollows.

The arm laid with Quickmatch both groove & hollow.



Then take the arm block, and put the
iron through it and through the hole in
the Arm, then adjust the screw holes of the
Block to those of the Arm and put in
the screws setting them tight home with
a turn screw: next screw the nut on the
Iron behind the Arm setting it very tight
with a wrench.

Take good 4 thread Cotton Quickmatch,
and

and to prevent waste, use short pieces of sufficient length, not cutting whole lengths of quickmatch without necessity - put a piece into each communication hole of the 1st block taking care they go down so as to touch the quickmatch in the hollow of the drum, then make room with your round pointed prickler and put in a second piece of quickmatch, make room again and put in a third piece sloping this last piece tight in with the point of the prickler, not so hard as to bruise the other pieces of match, but just sufficient to keep them tight in the holes; then with a pair of scissors cut off the ends of quickmatch level with the rim of the tin ferrule.

• All the drums to be prepared in the above manner; and to be secured with pasted double whited brown paper laid
all

all along the Groove from the shoulder at the screw to the arm block, all round under the Block and beyond the Block over the end of the Arm, observing to fill up that part of the groove beyond the Block, where there is no quickmatch, with pieces of the pasted paper stopped tight in and then covered over, they must have a second layer of double paper all over the first coat, pressing the paper very close every where, then lay them in a Room to dry, four or five days.

The paper slips for pasting with, must be nearly equal in breadth to the breadth of the Arm which must be considered before the paper is torn out, for we do not cut them; the torn edges laying closer and are not so subject to rise in drying.

When the pasting of the Arms is dry,
the

the Wheels may be put on, (if complicated as before directed,) taking care to put the proper Wheel on each Arm according to the corresponding marks or Numbers on each:

Screw the small Nut at the end of the spindle iron, tight with the fingers, then with the left hand lift up the Arm with the wheel, holding them perpendicular, give the Wheel two or three turns to see that it plays or turns round as freely as possible without the least rub or hinderance, if there is any defect, it must be examined and rectified — All the Wheels to be put on, tried and examined, in the same manner, leaving the Wheels upon their Arms: then take slips of whited brown paper and put one round the screw of each Arm twisting them at the end to preserve the Spickmatch; and lay them by till an opportunity for Varnishing them; which is always done when there is

is a quantity of the Work prepared and quite dry, and not varnishing every little article as they become fit.

To communicate the Grand or Center Blocks into which the Arms are to be screwed.

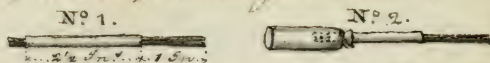
Fig. 1. shows the Center Block with its tin ferrule, two of the screw holes for the Arms, and the middle hole for the Iron, with the two communication holes are represented by the dotted Lines.



Fig. 2. is a Section of the Center Block supposed to be cut through from b to d, in order to show the 4 screw holes a, a, a, a. in the middle is the hole for the iron with the excavation made round it by the intersection of the holes, and which is always equal to the size and number of the holes; c, c, are two communication holes about $\frac{1}{4}$ of an inch in diameter, these are opposite to each other and bored through exactly in the middle line of and between the screw holes.

holes as at C, Fig. 1.

First prepare two short pieces of cartridge paper leaders that will go into the holes, in the following manner,

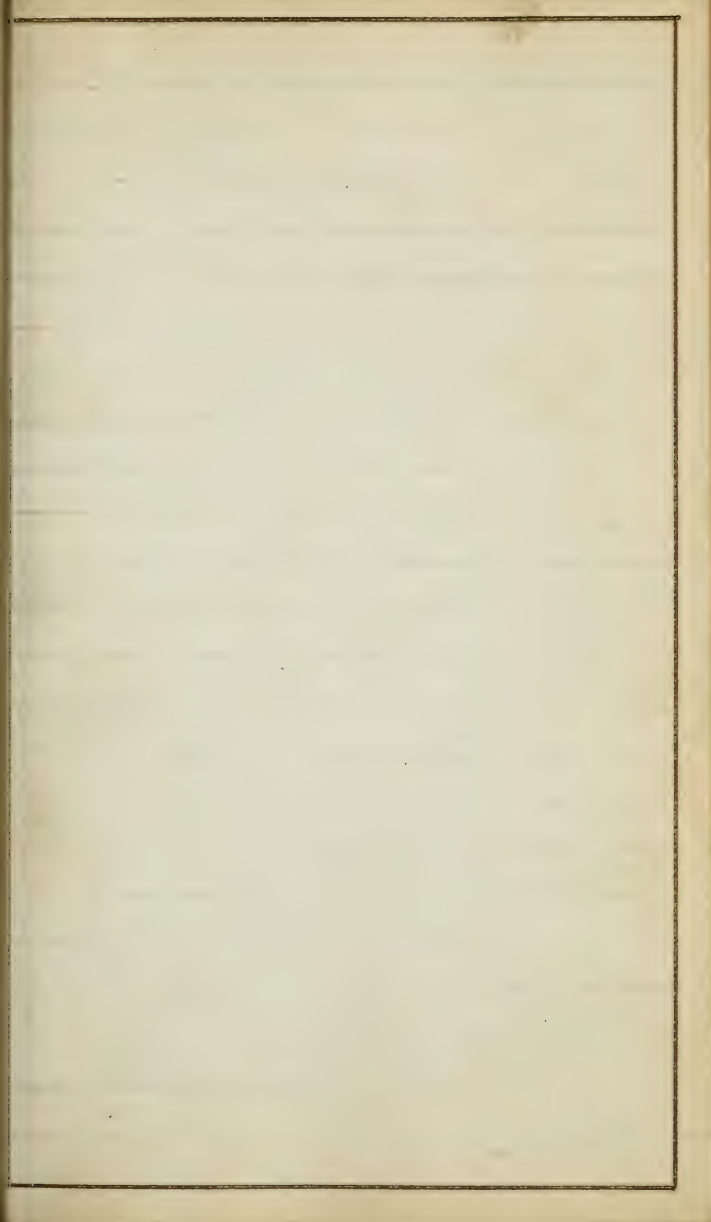


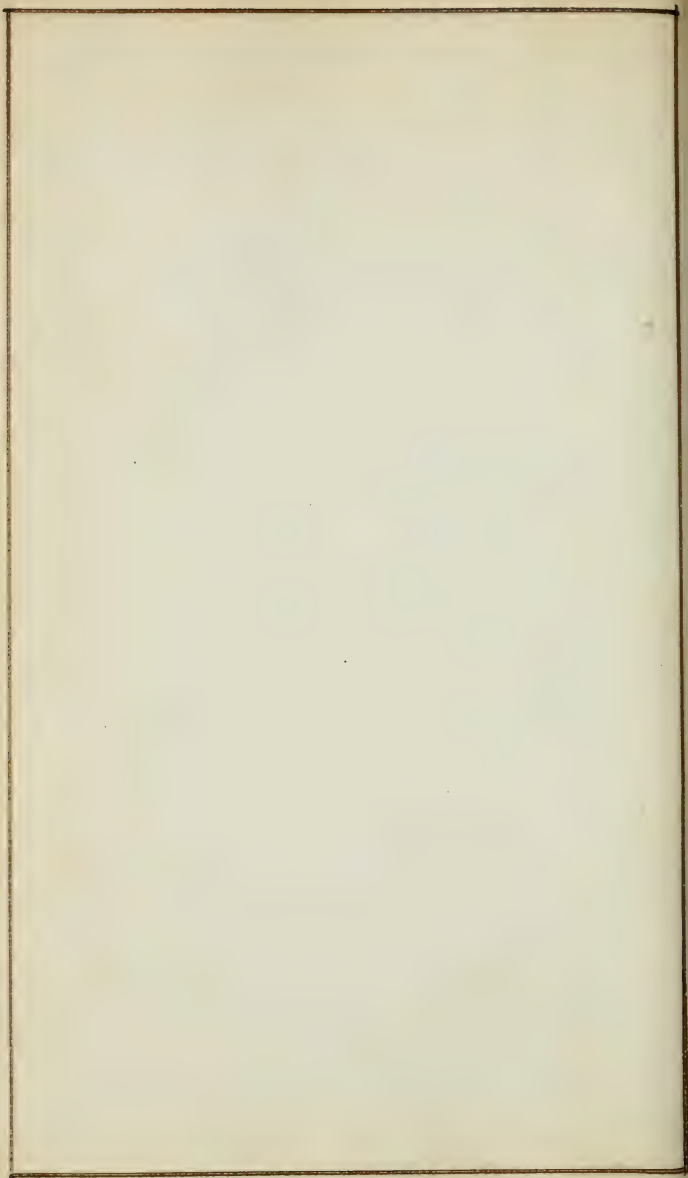
N° 1. represents the Leader quickmatched.

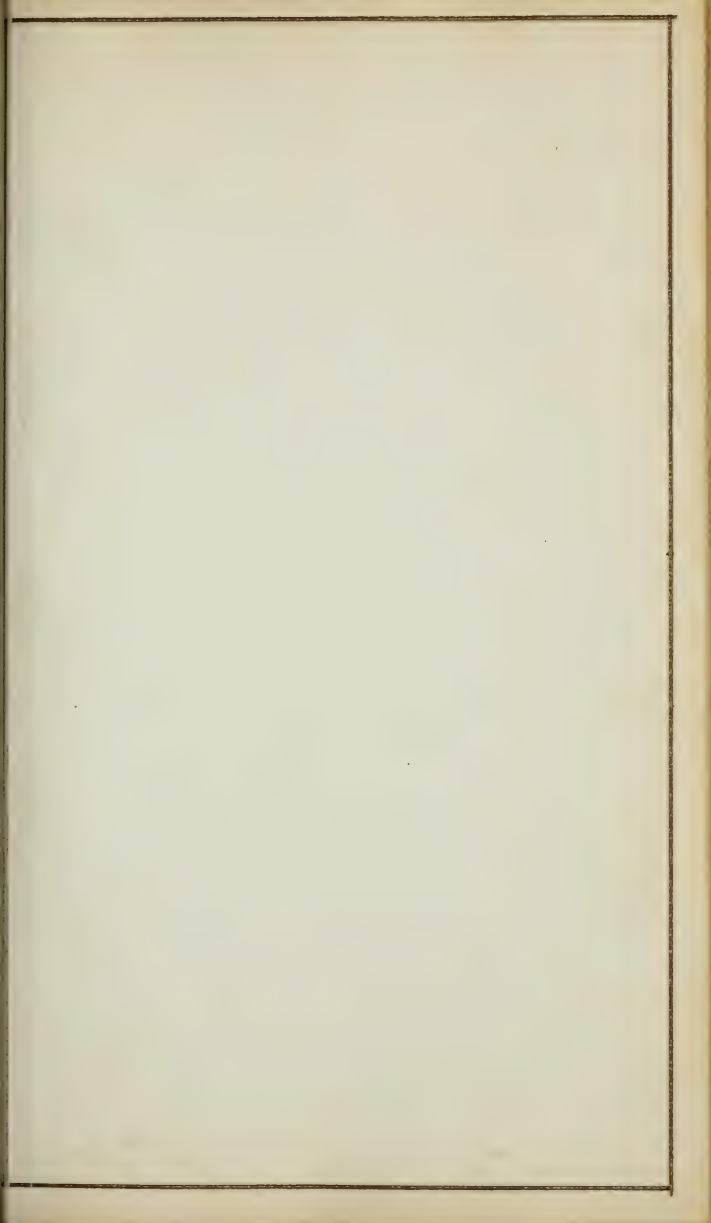
N° 2. represents the same Leader with a single, varnished Cartouch choked and tied on to it: observing to prepare as many of these Leaders as are necessary, two for each Center Block.

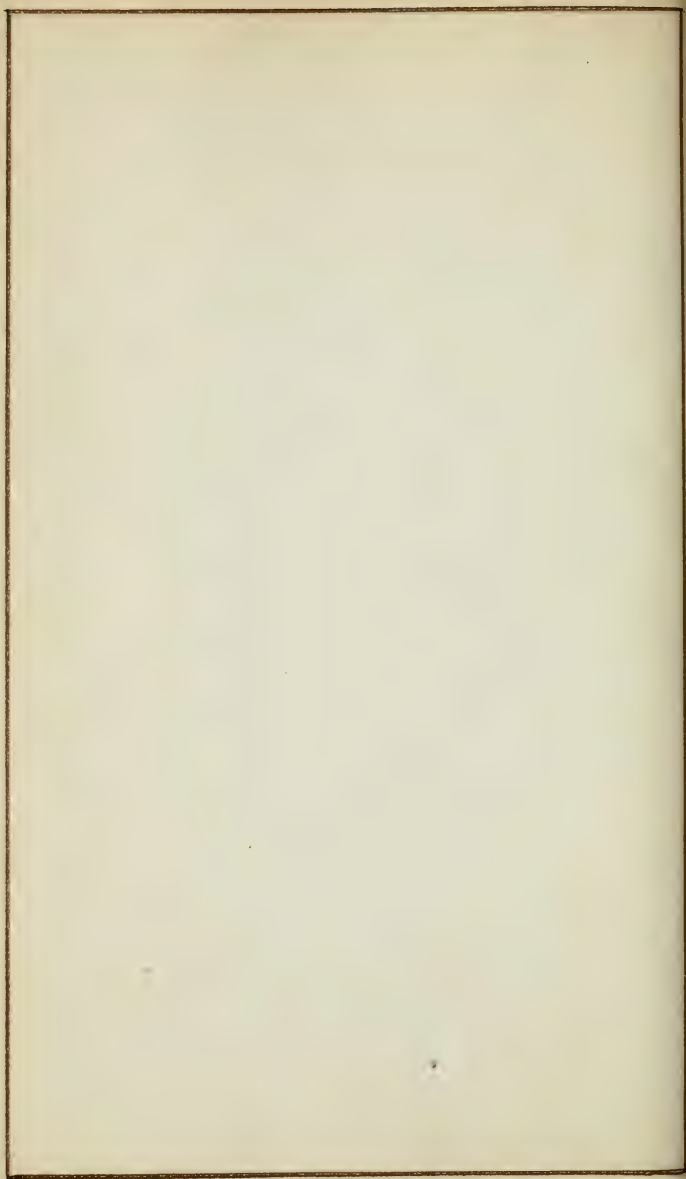
Fig. 3. Is a Section of the Center Block cut through from top to bottom, in order to show the

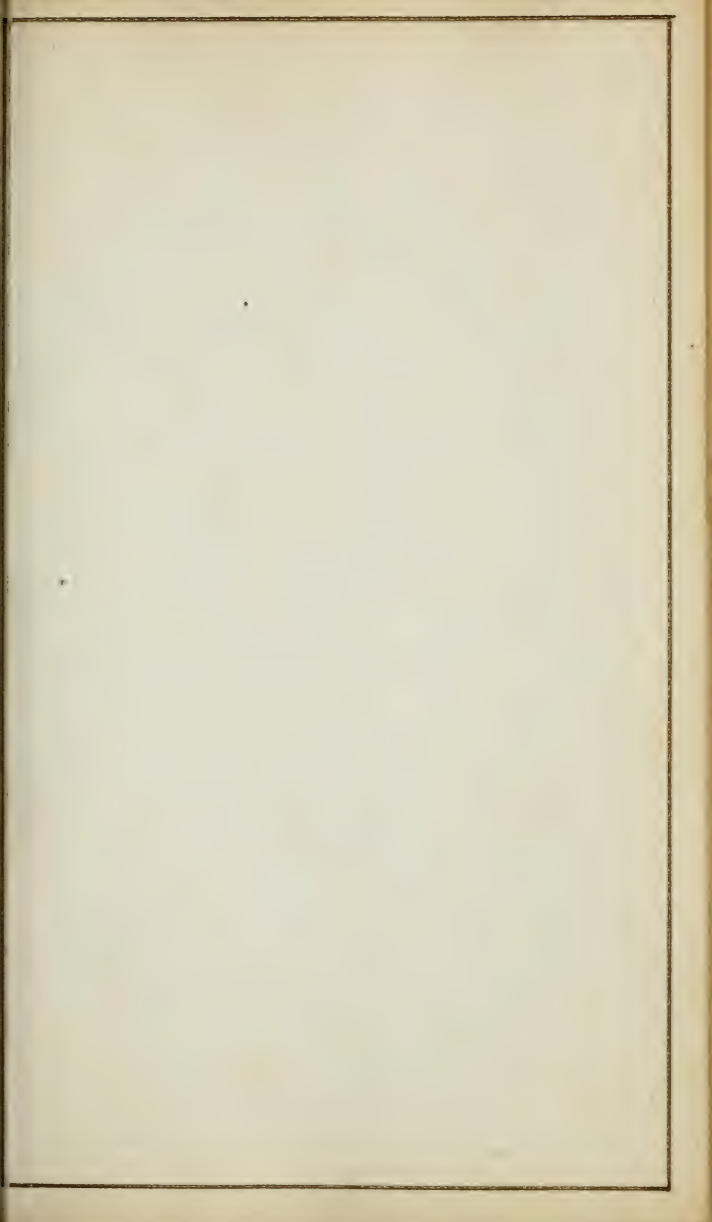


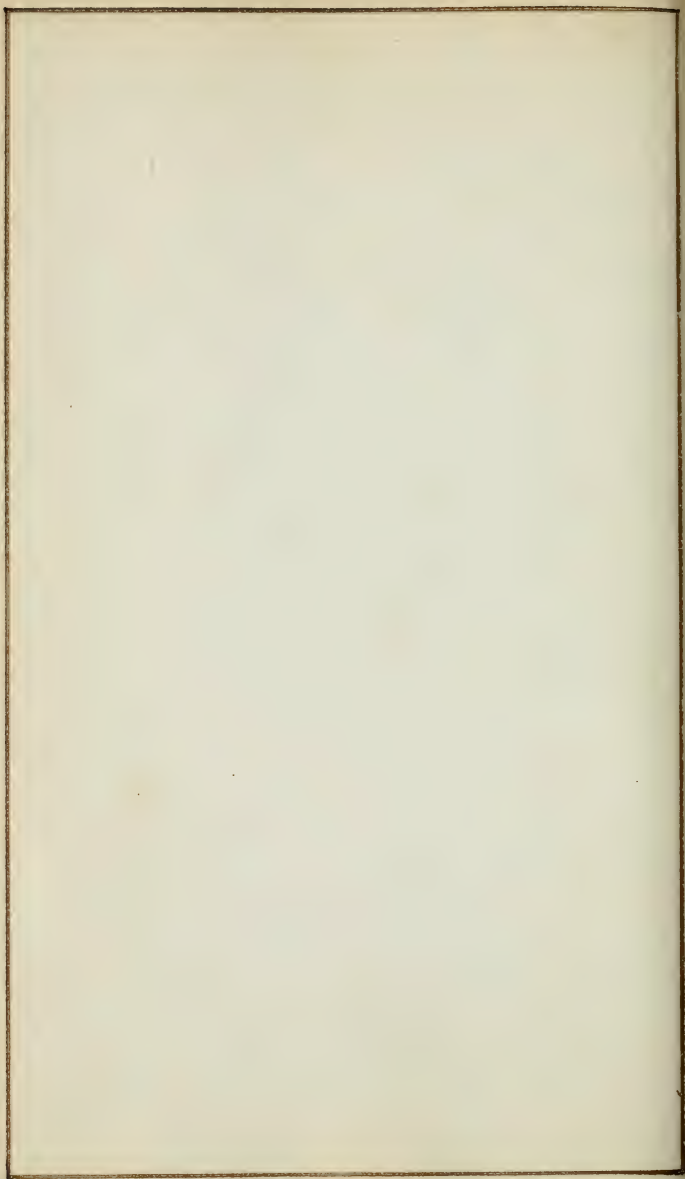


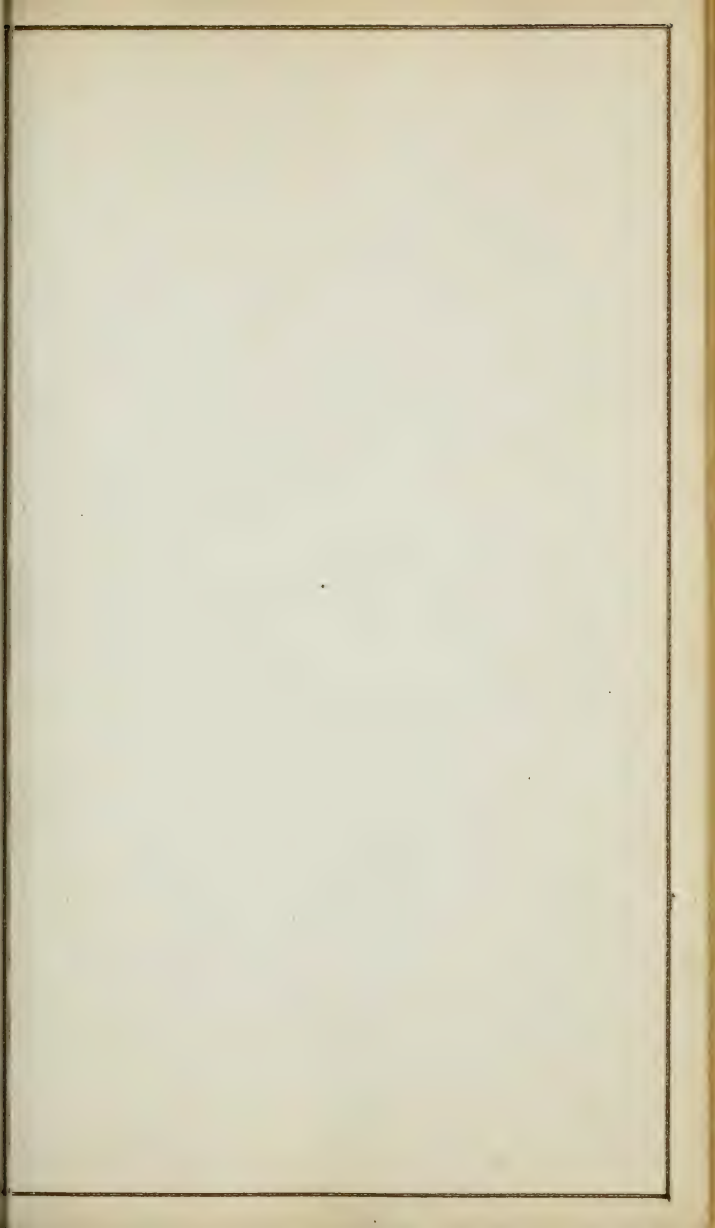


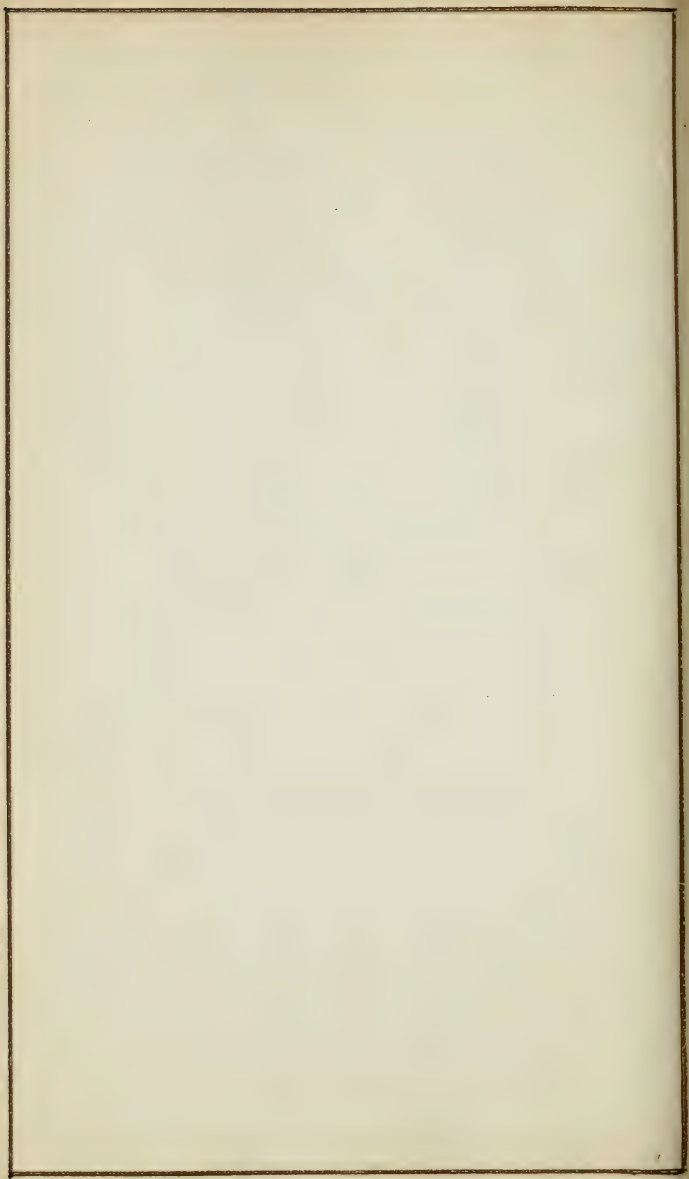


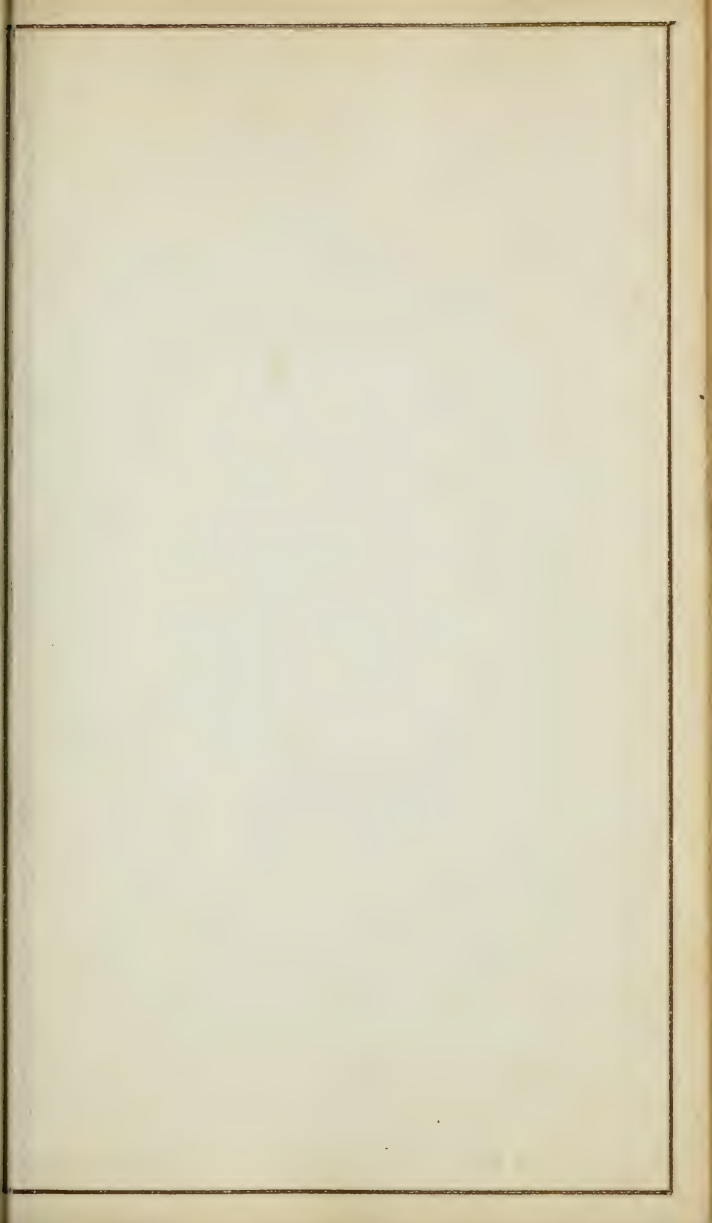


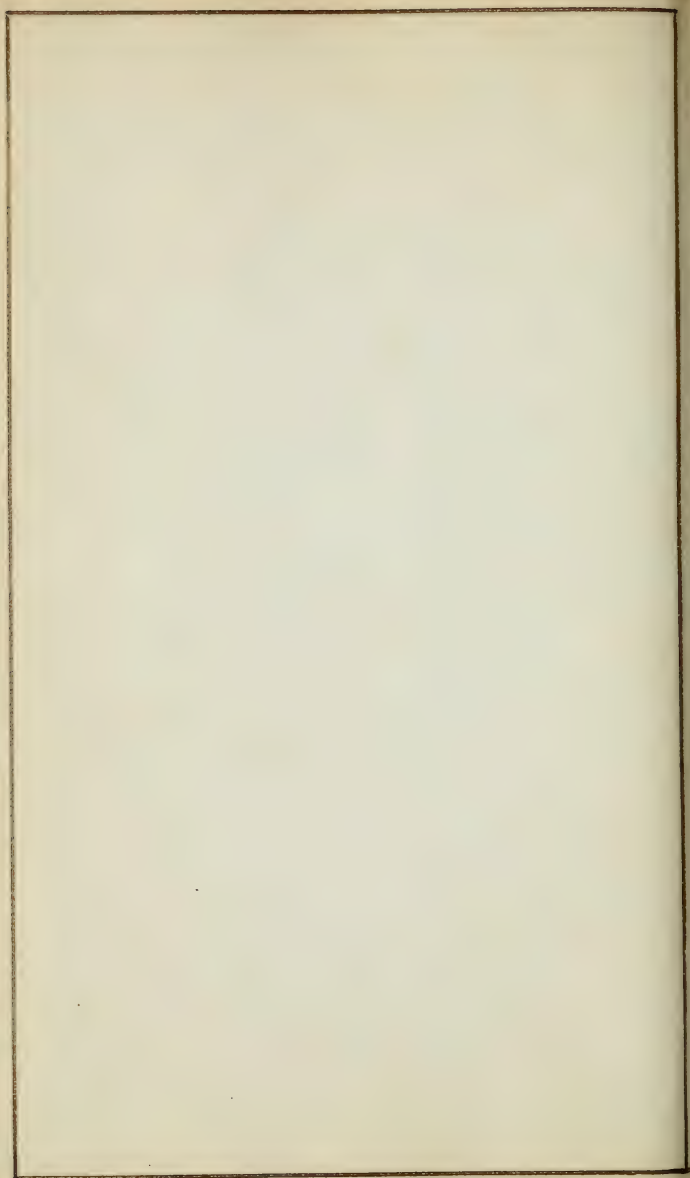


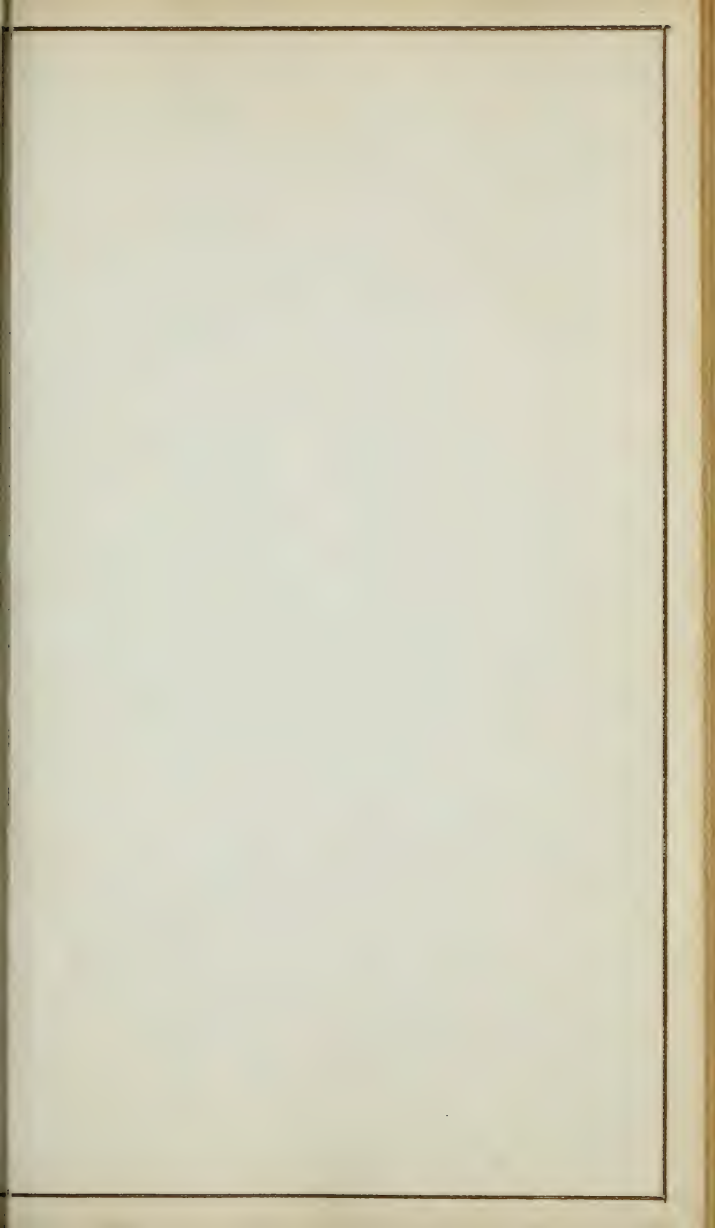


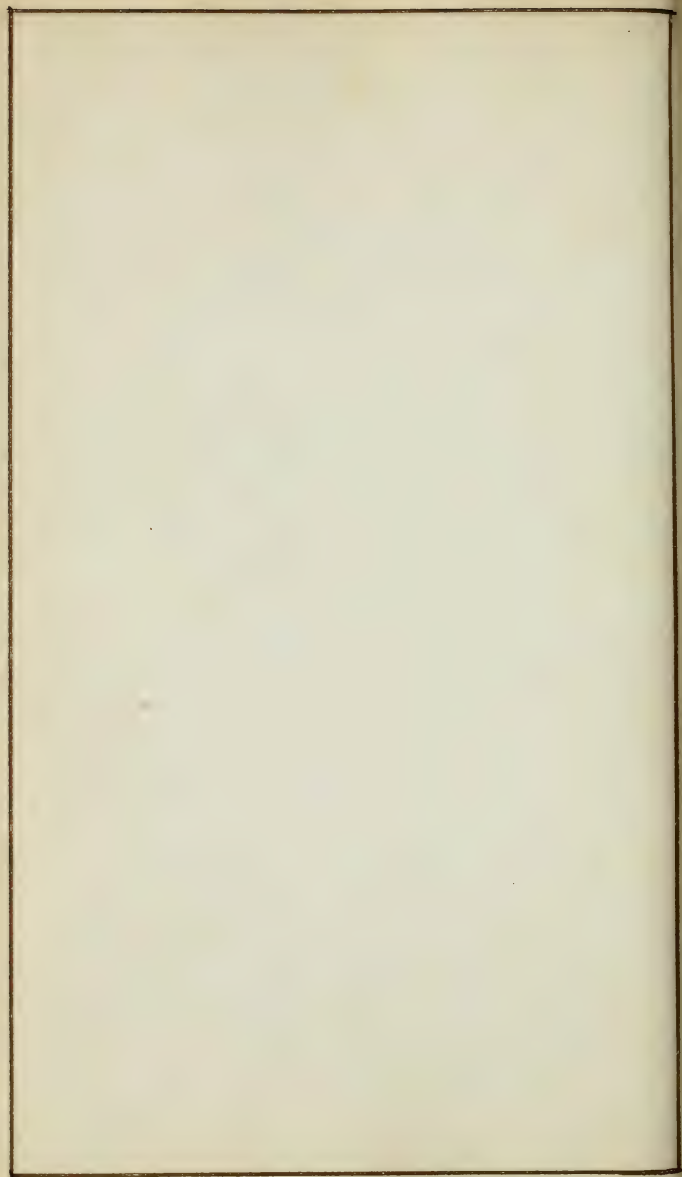


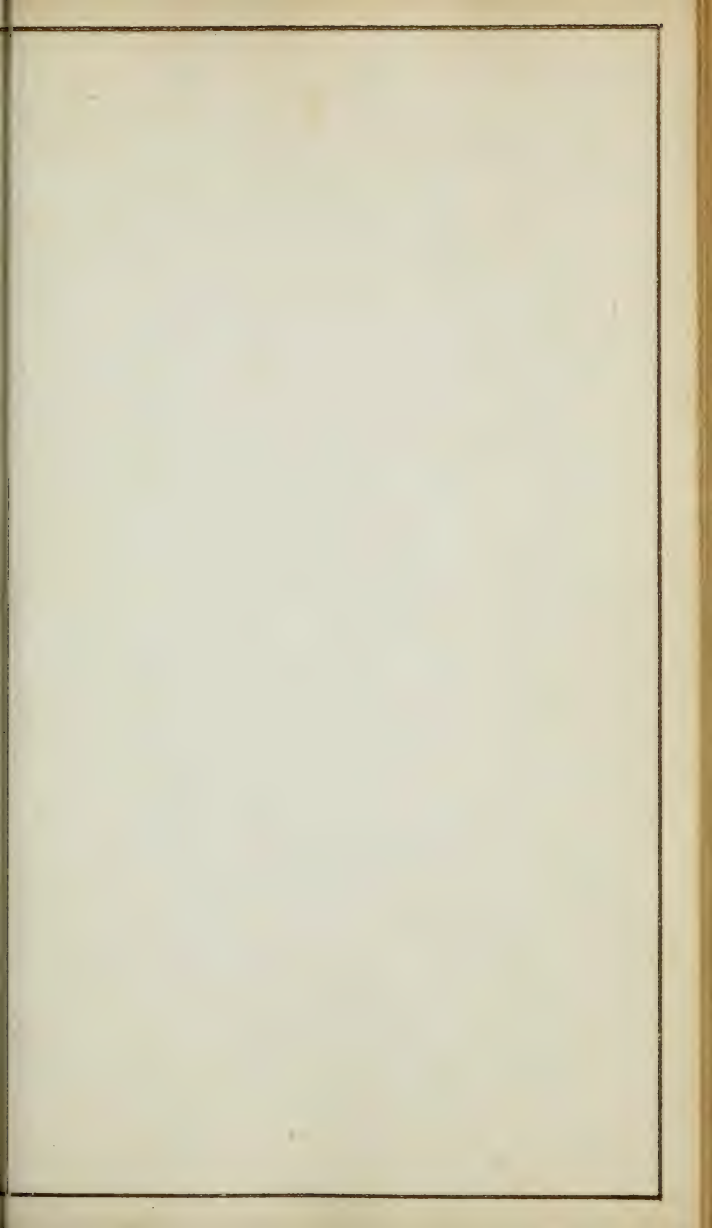


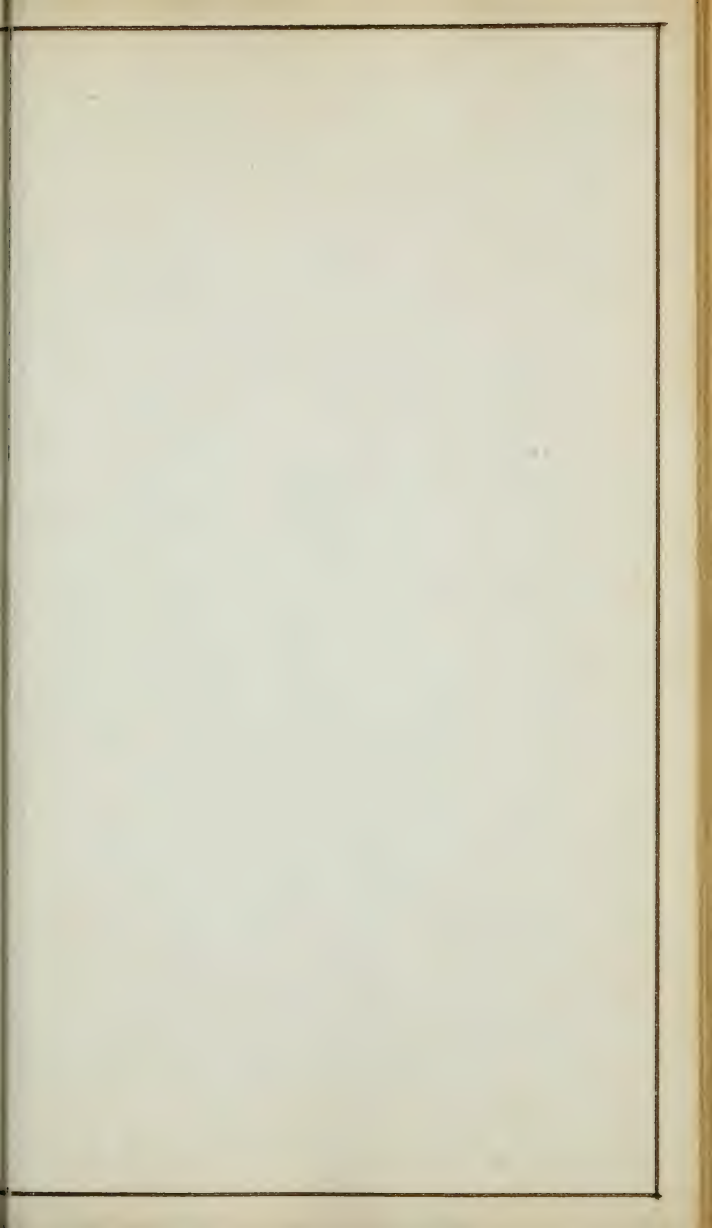


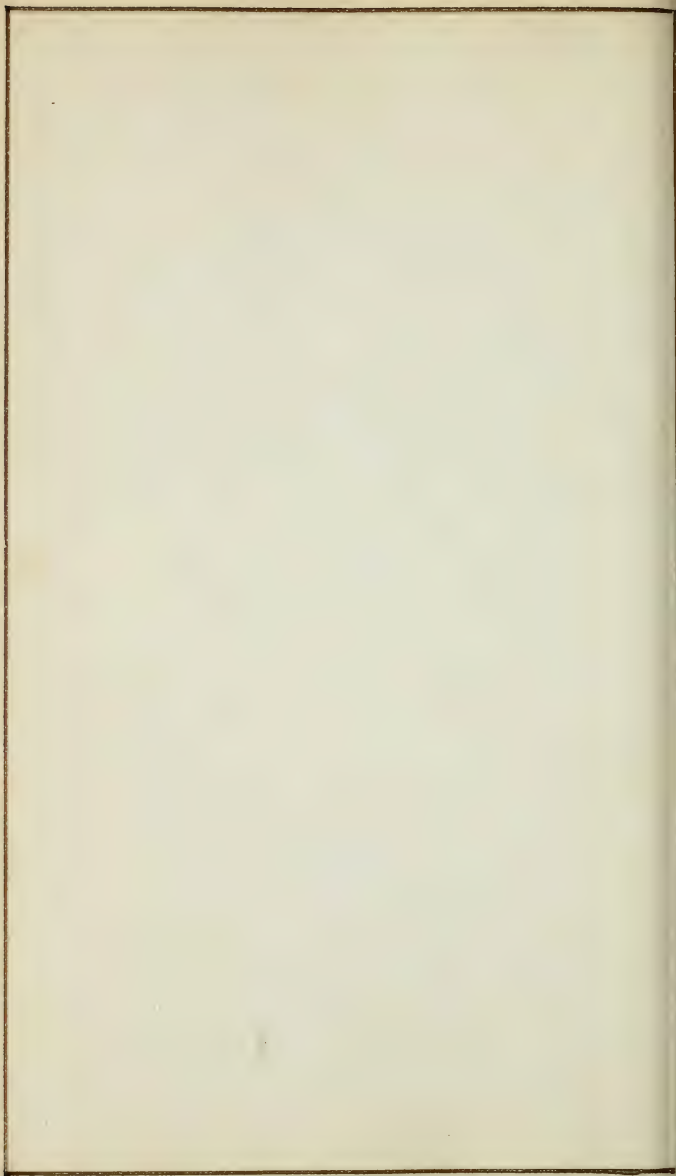


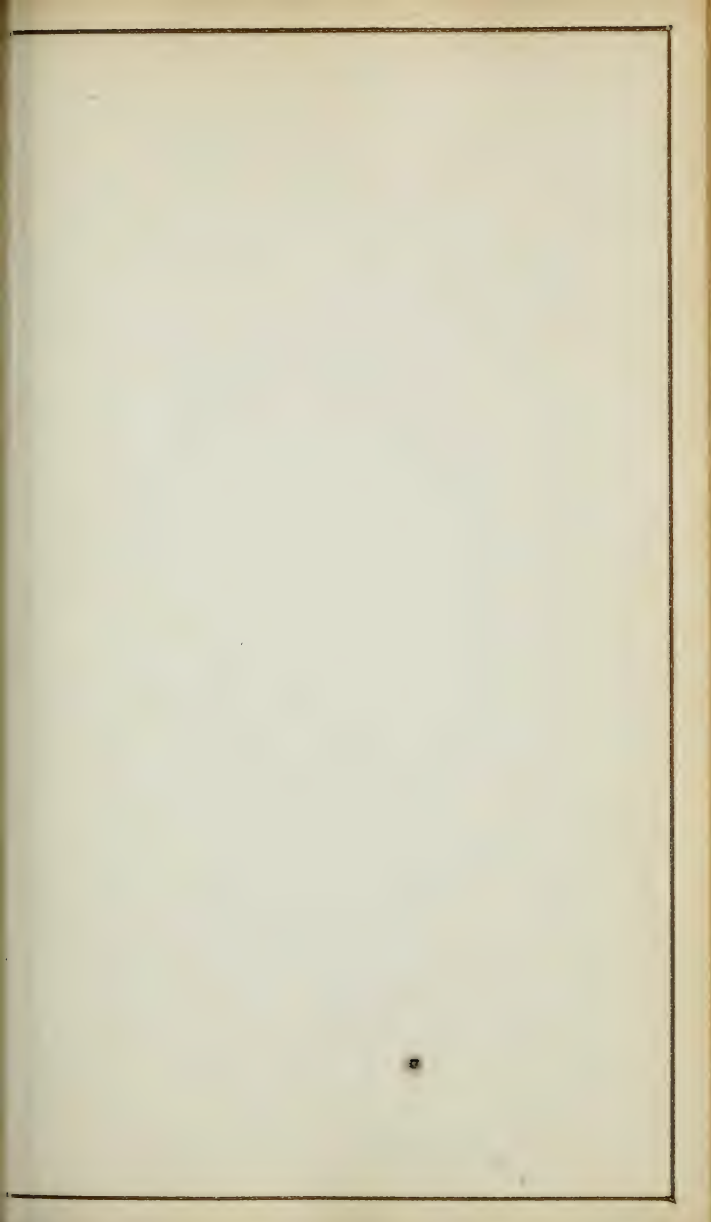


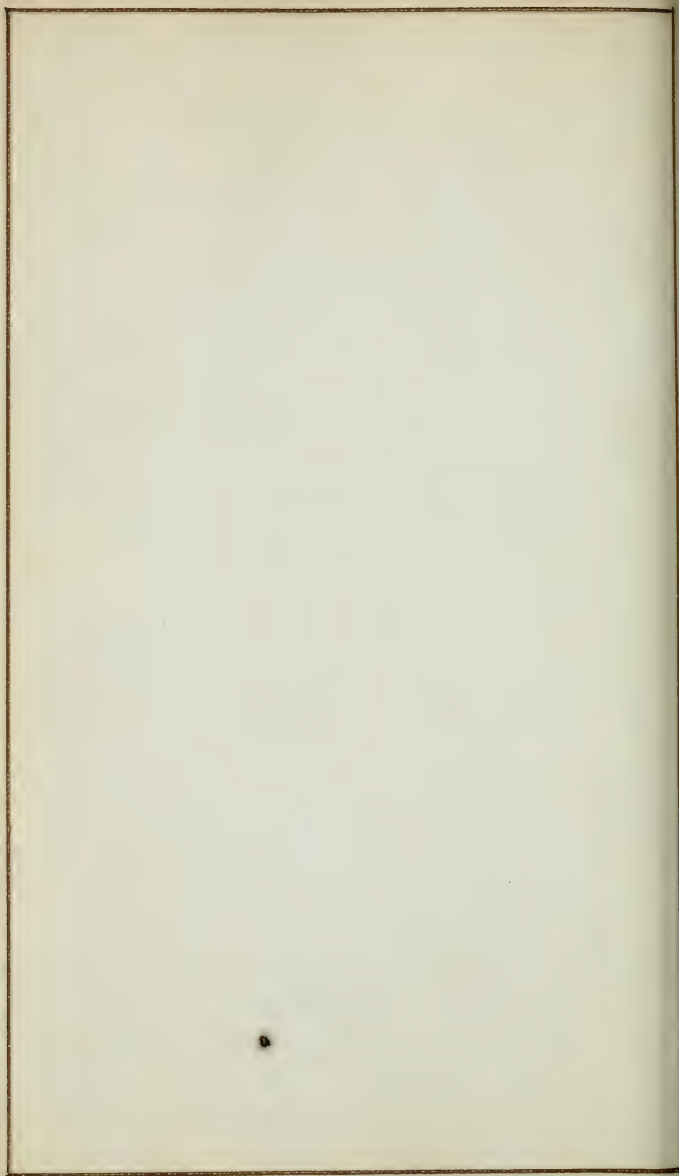


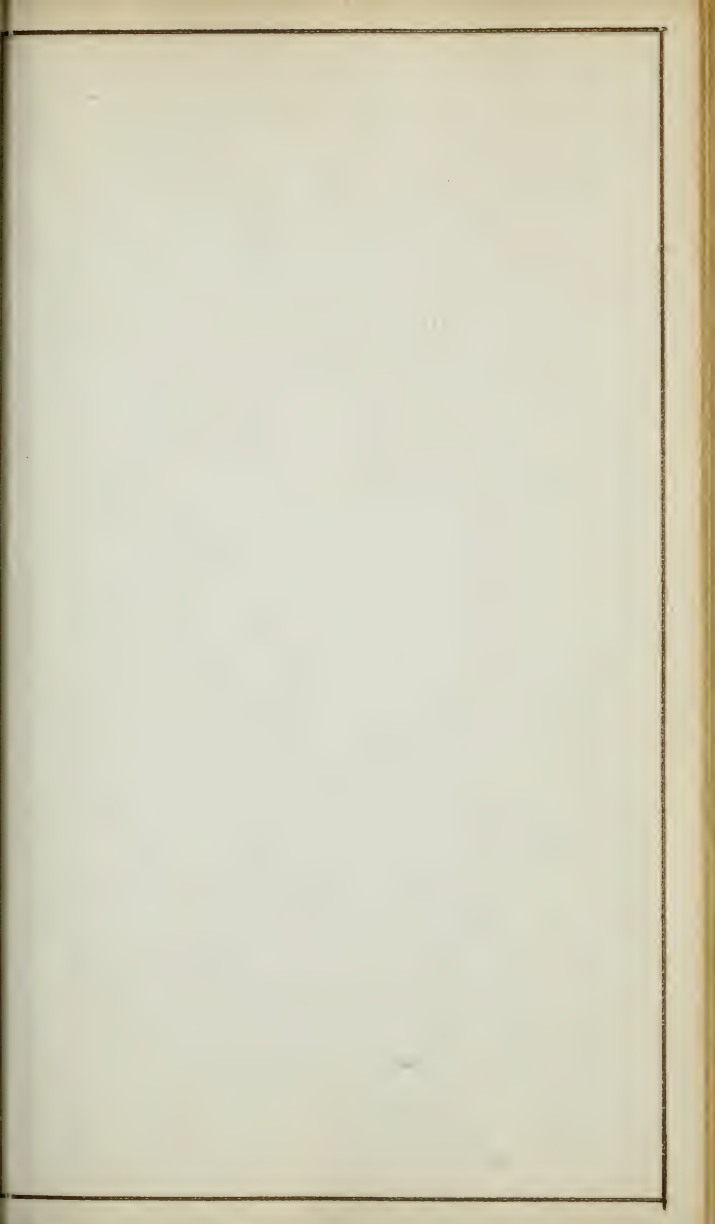


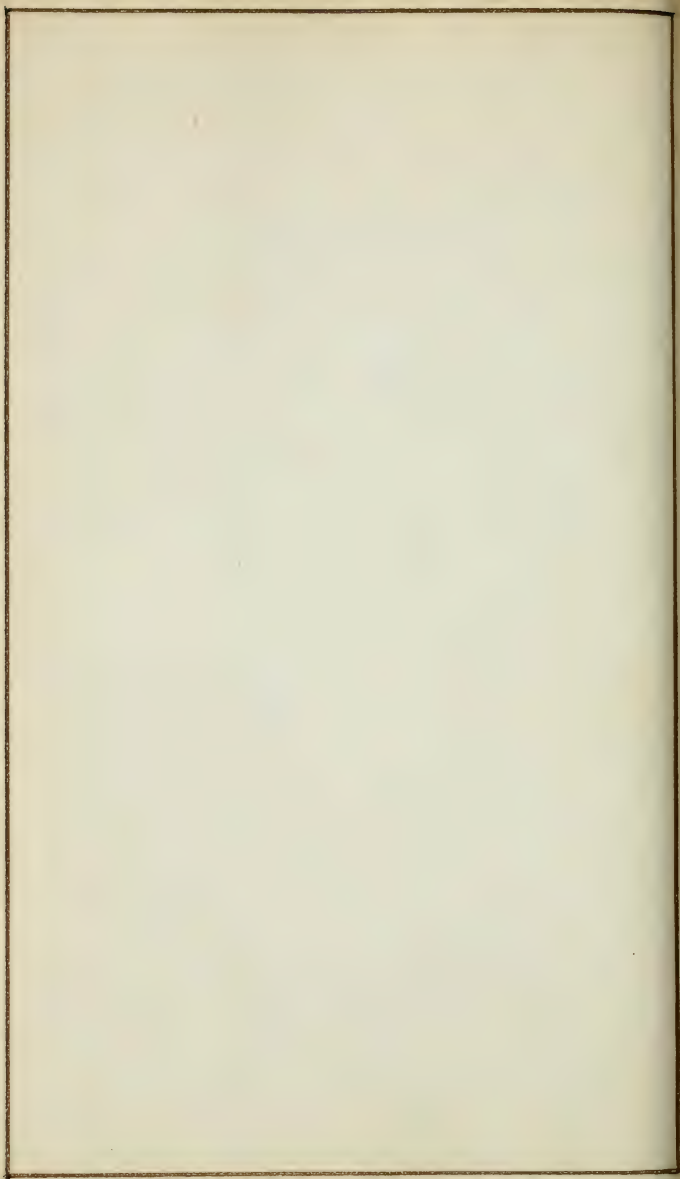


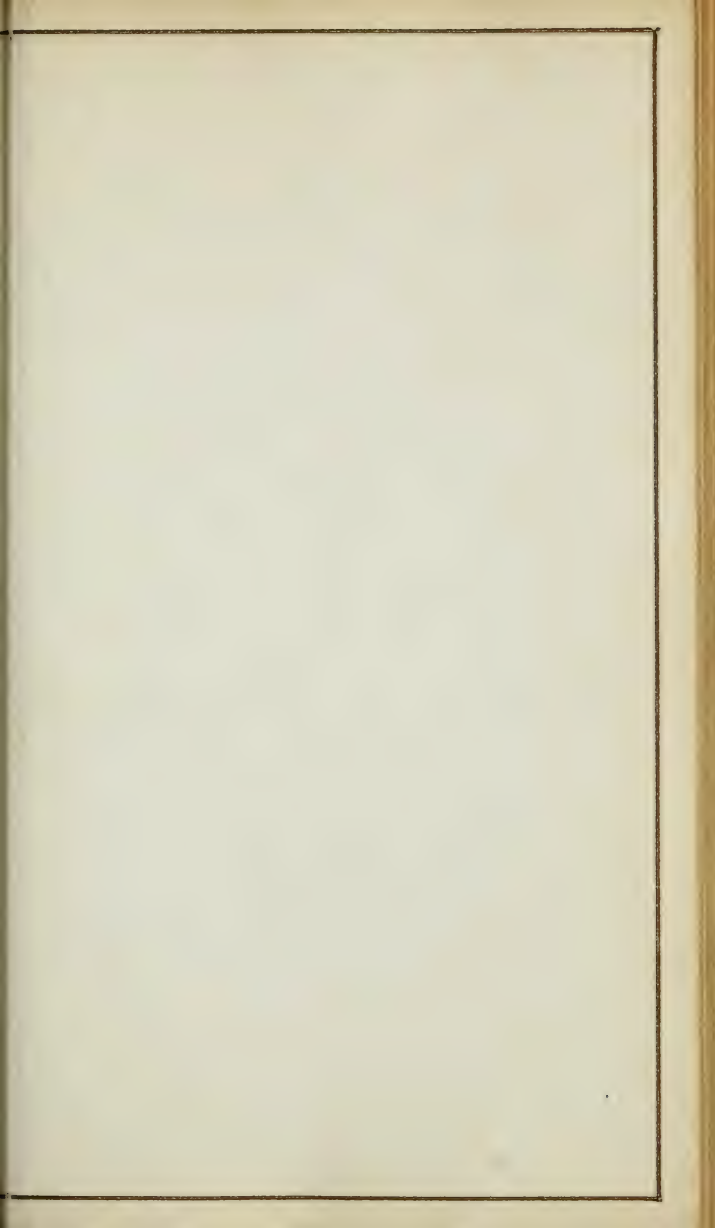




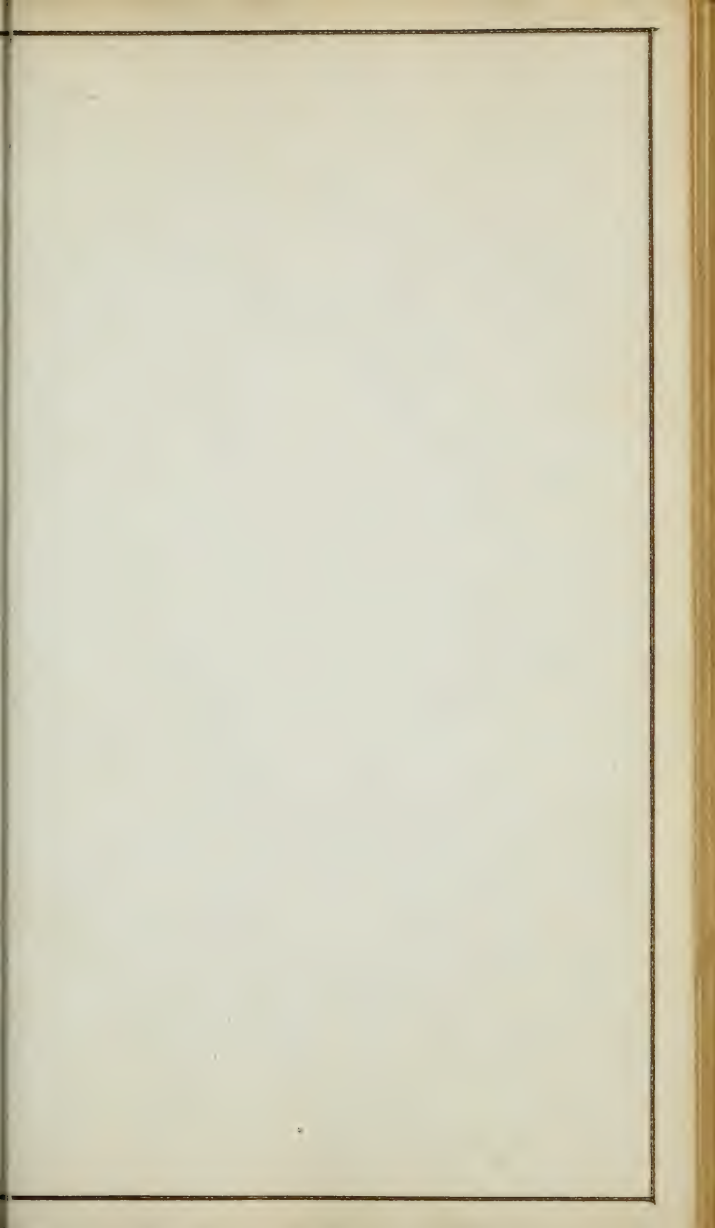


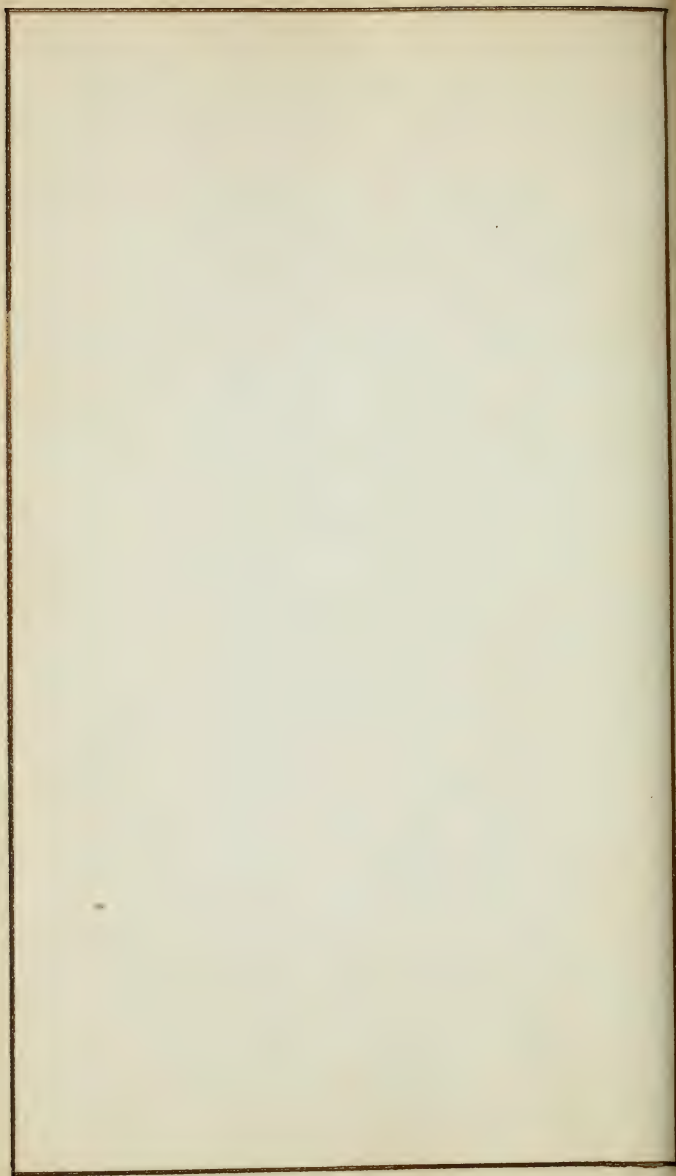


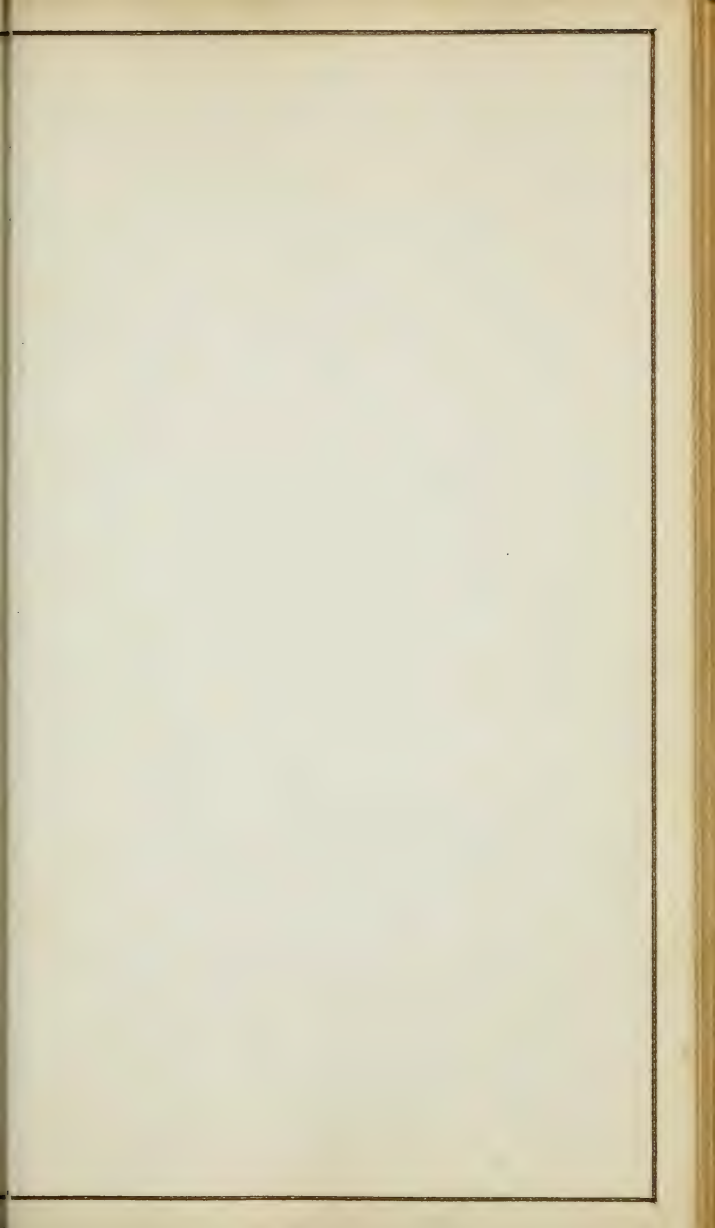


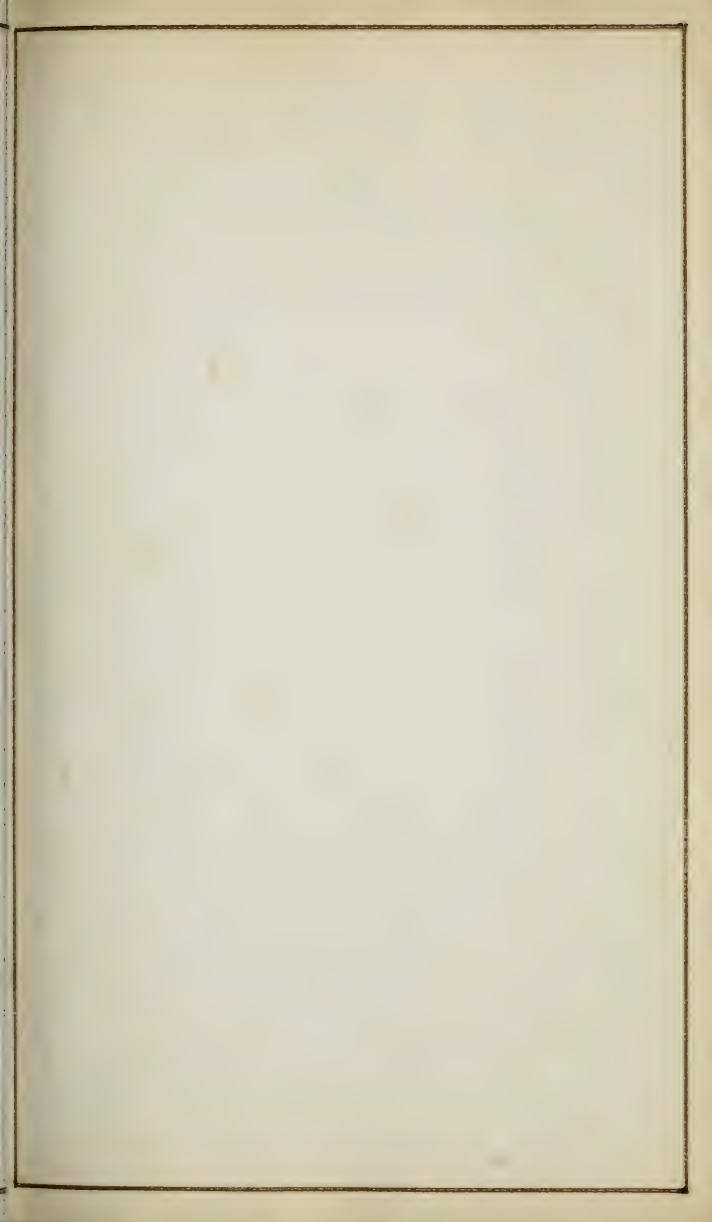


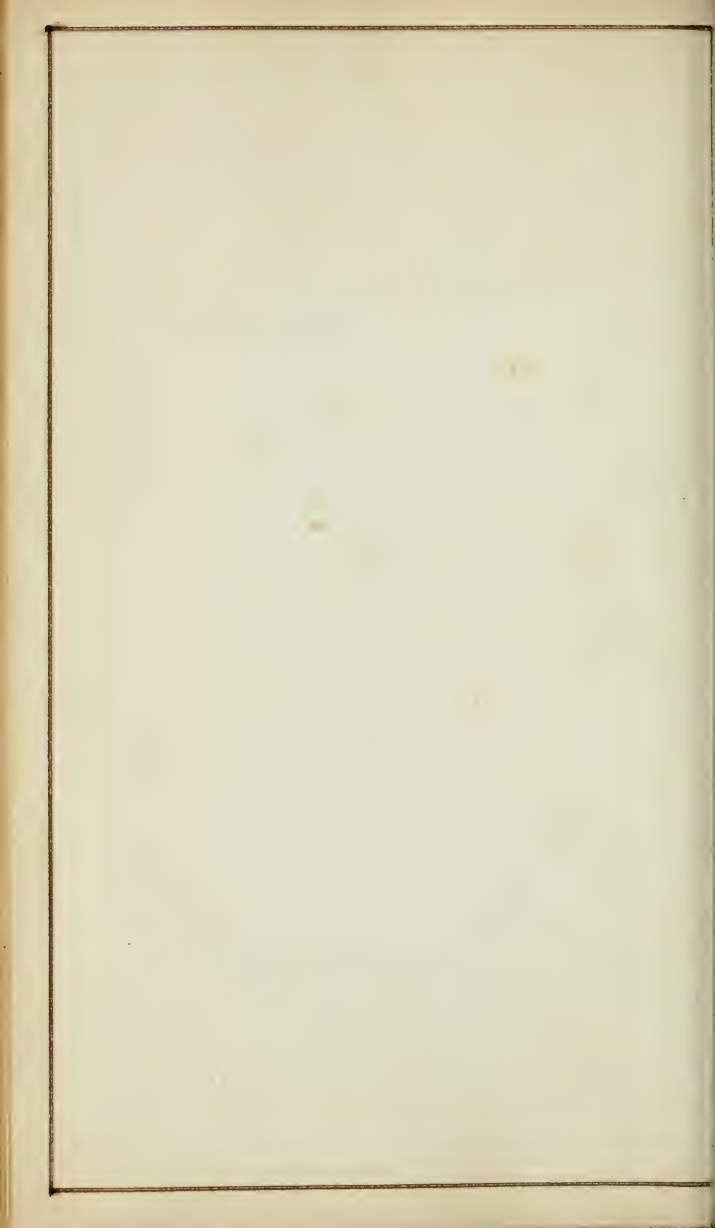


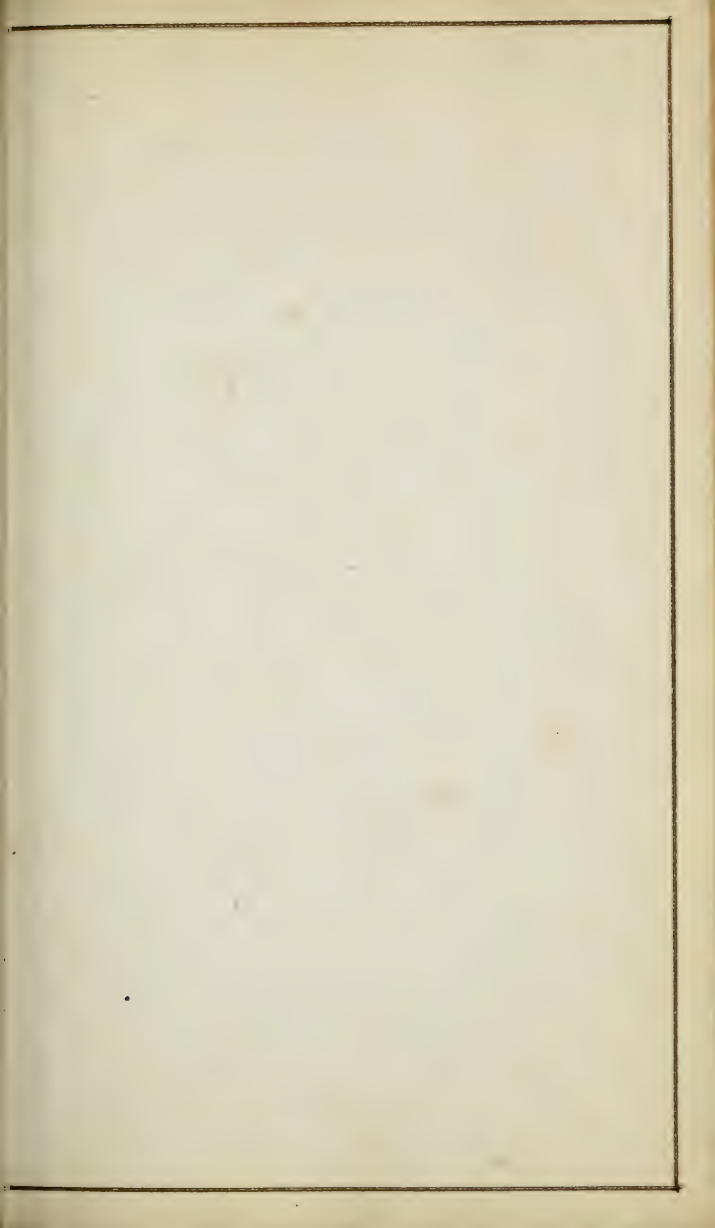


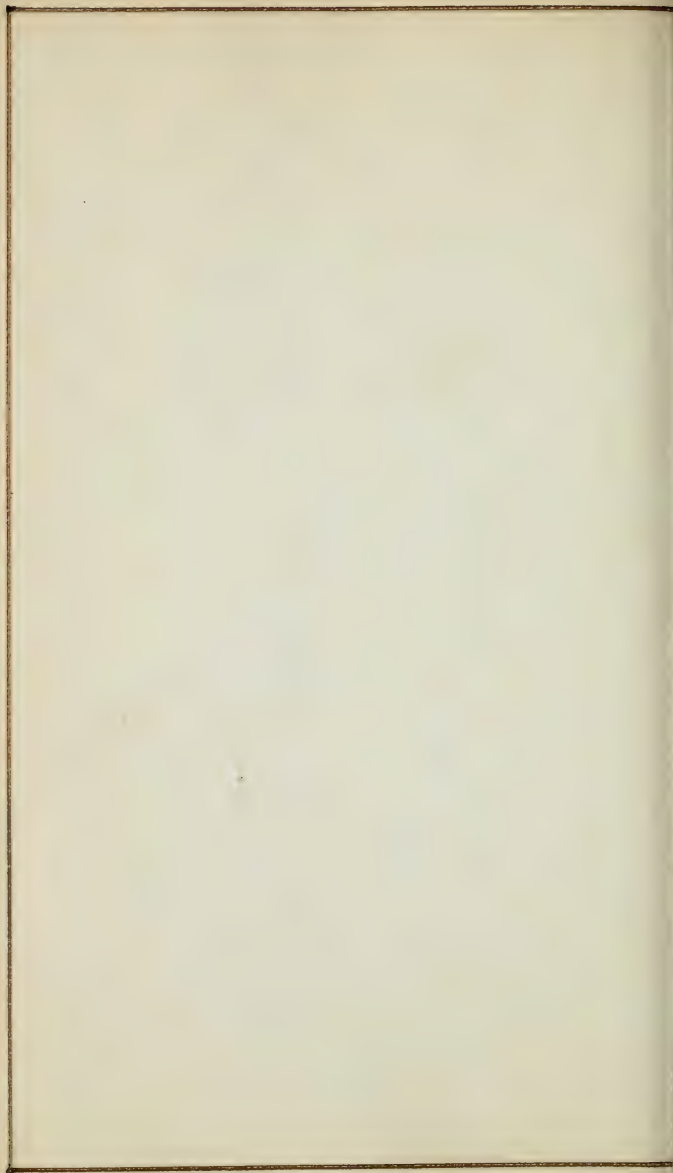


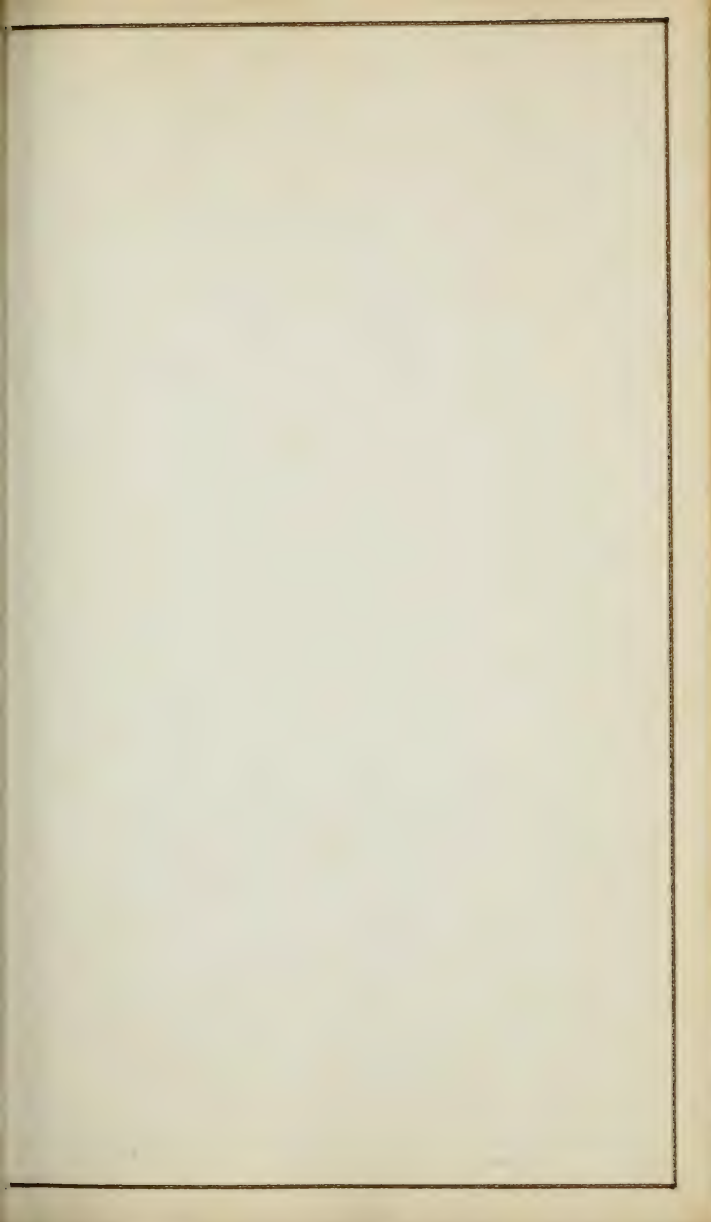




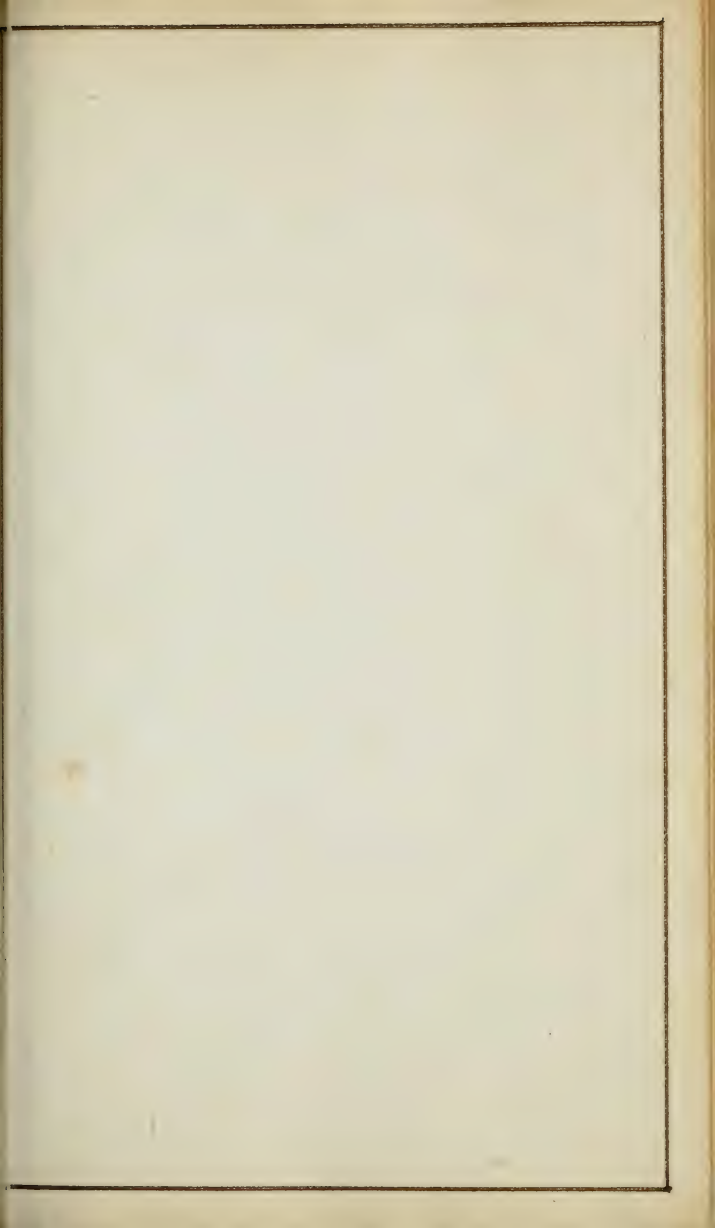


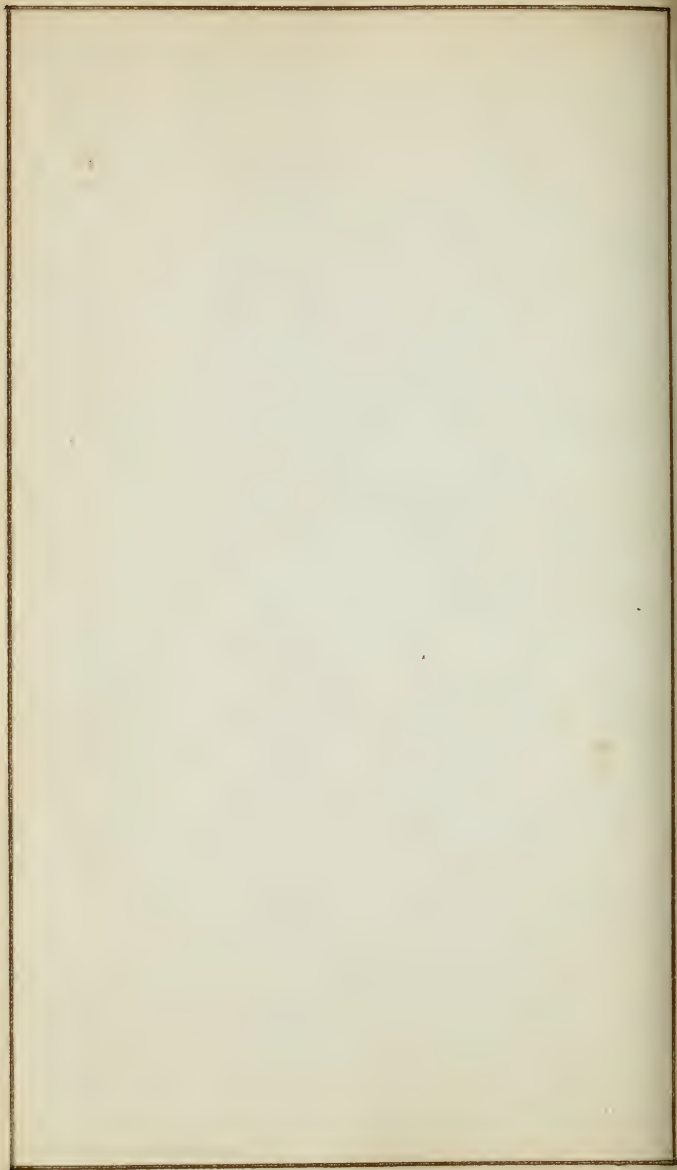


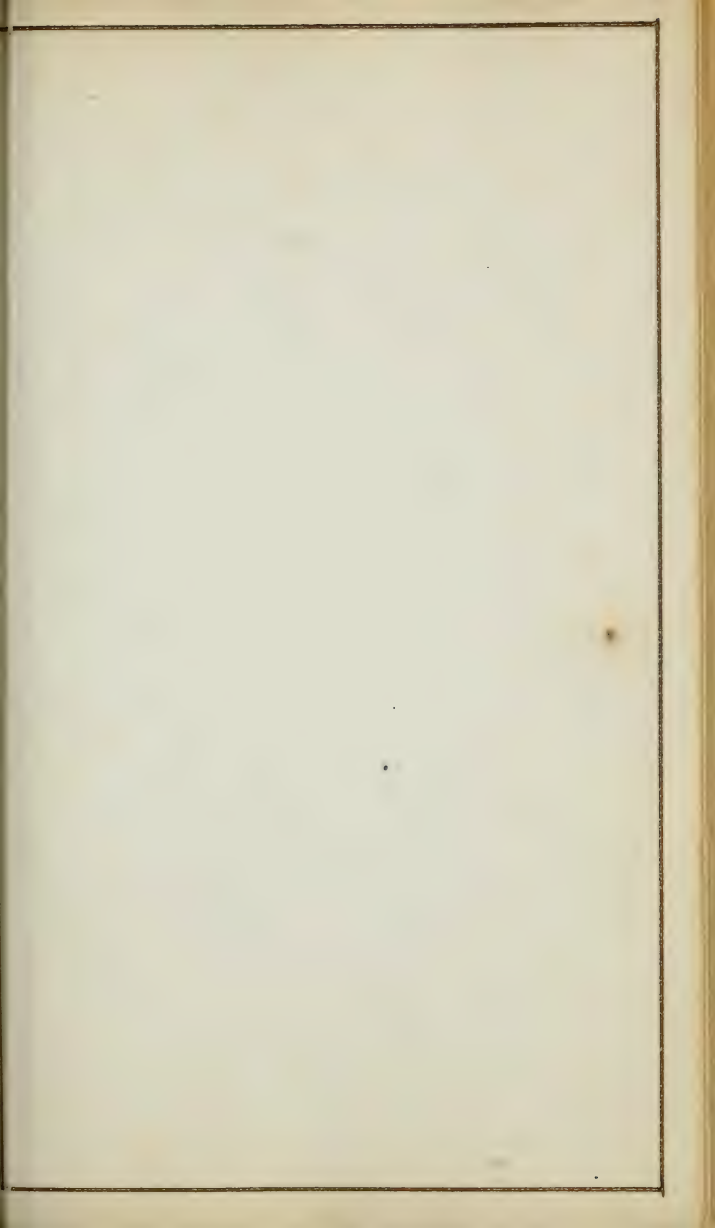


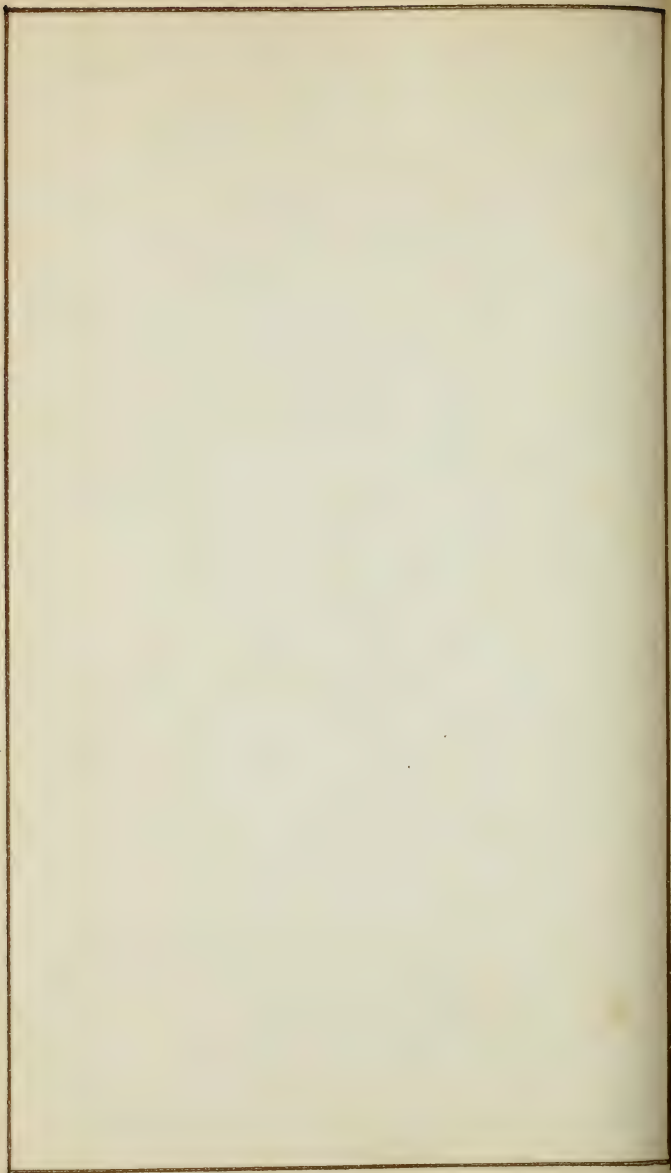


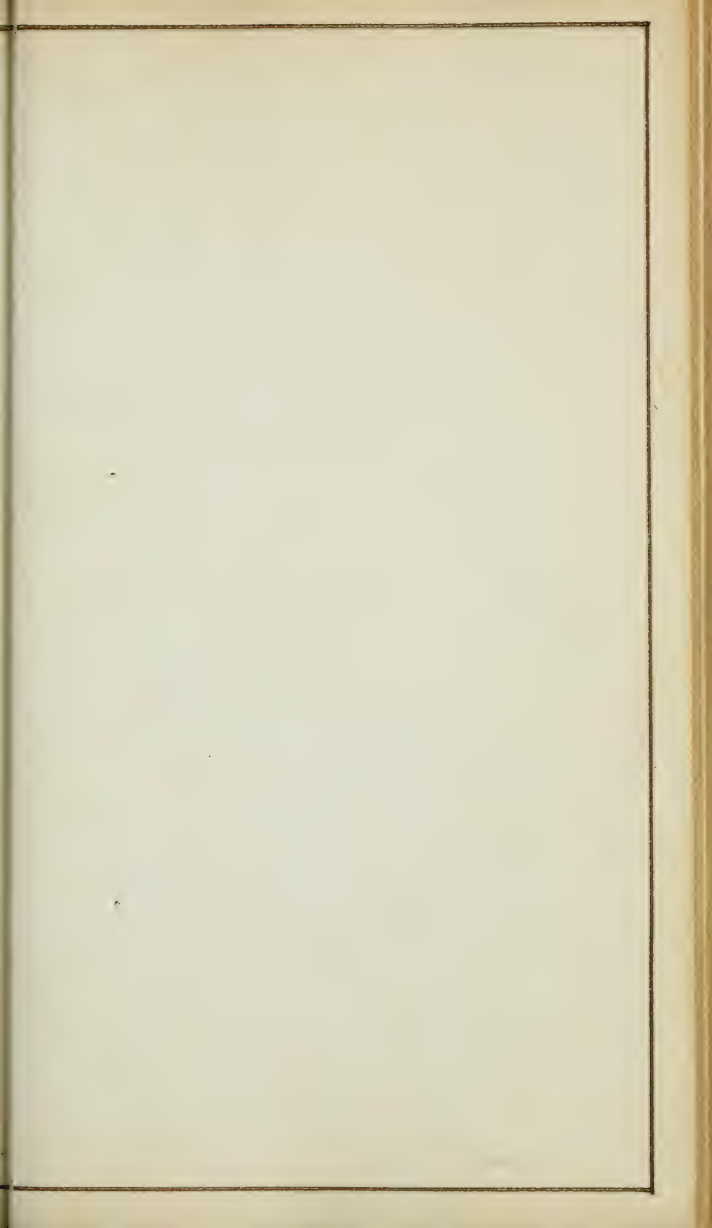


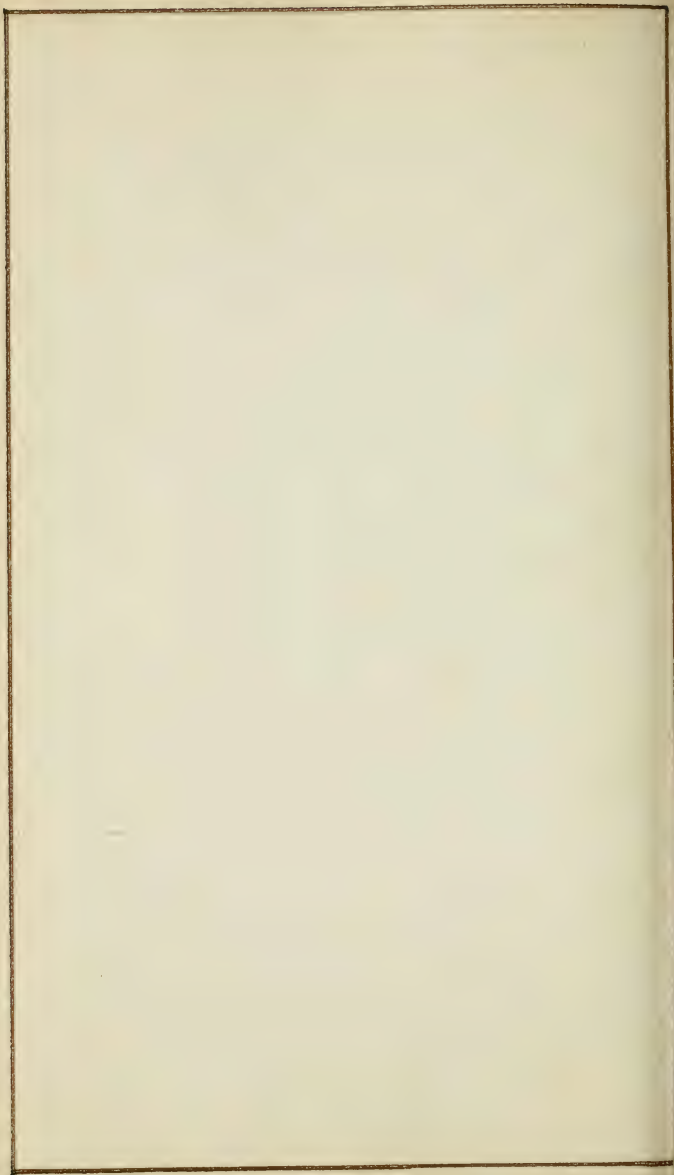


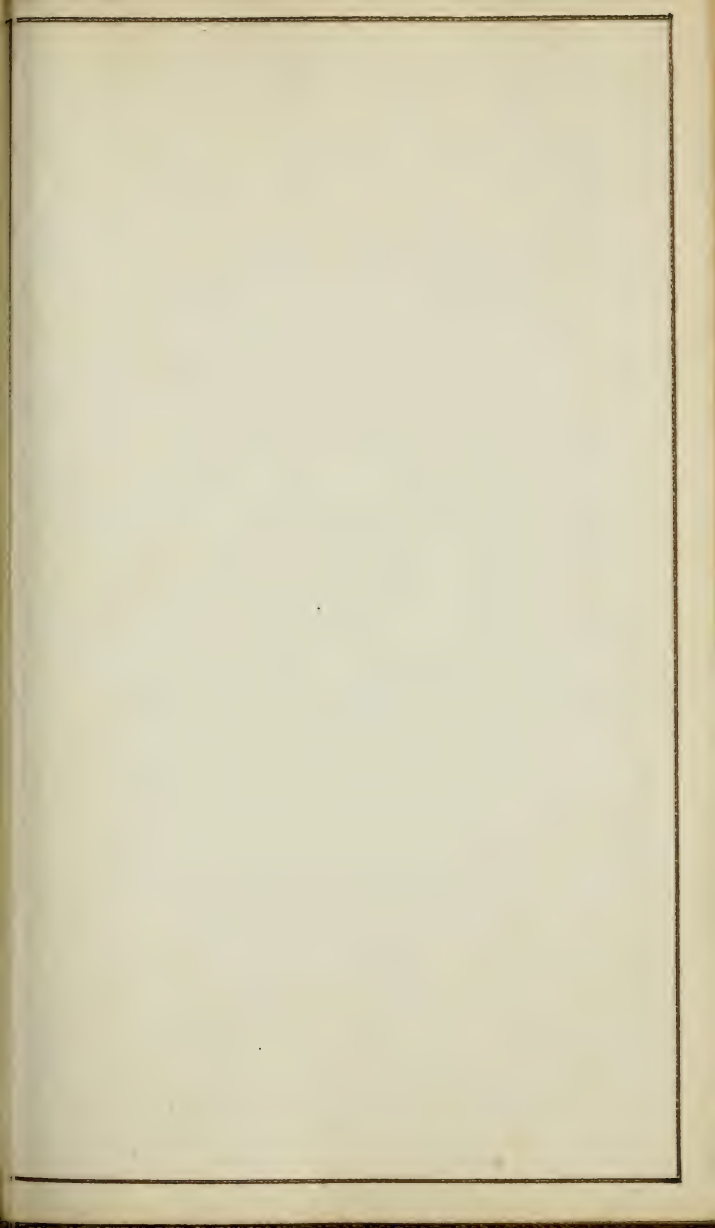


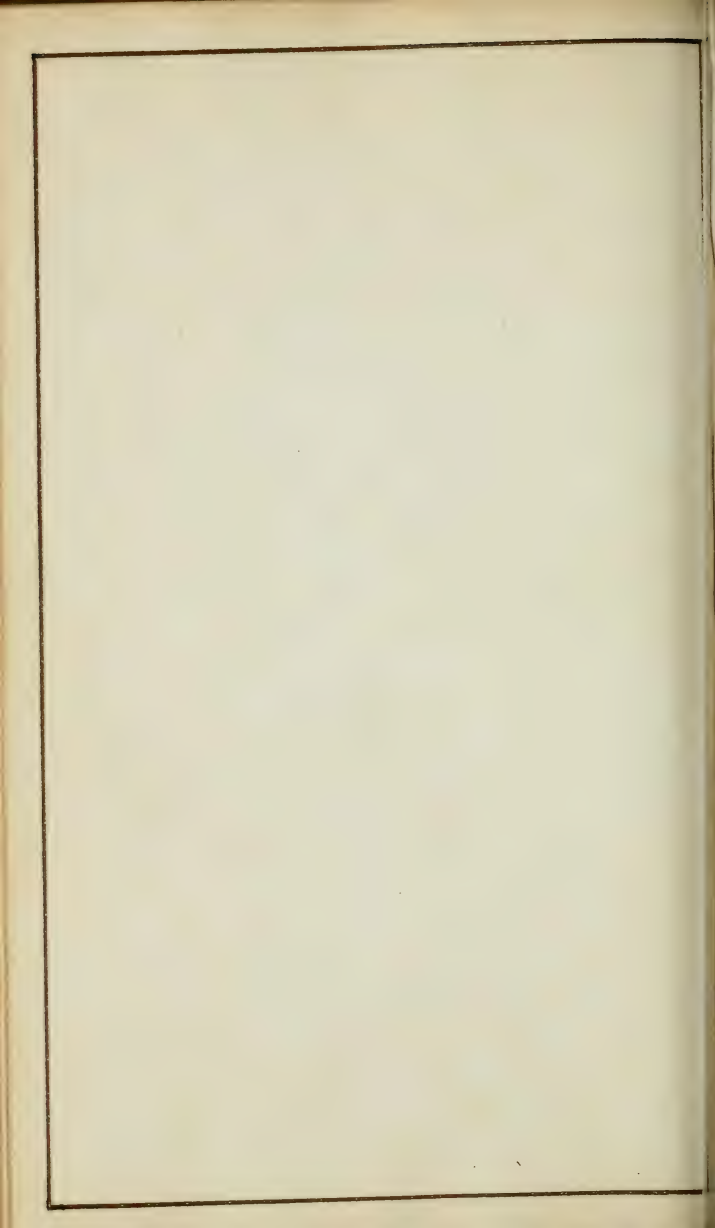


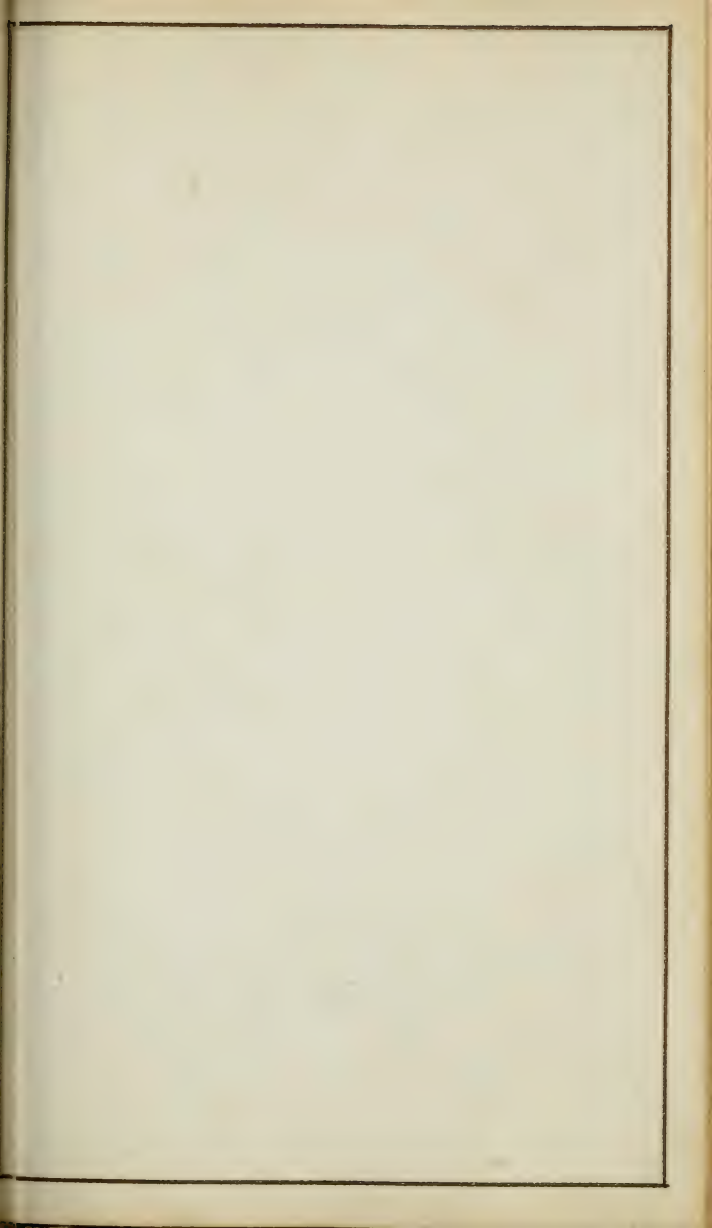


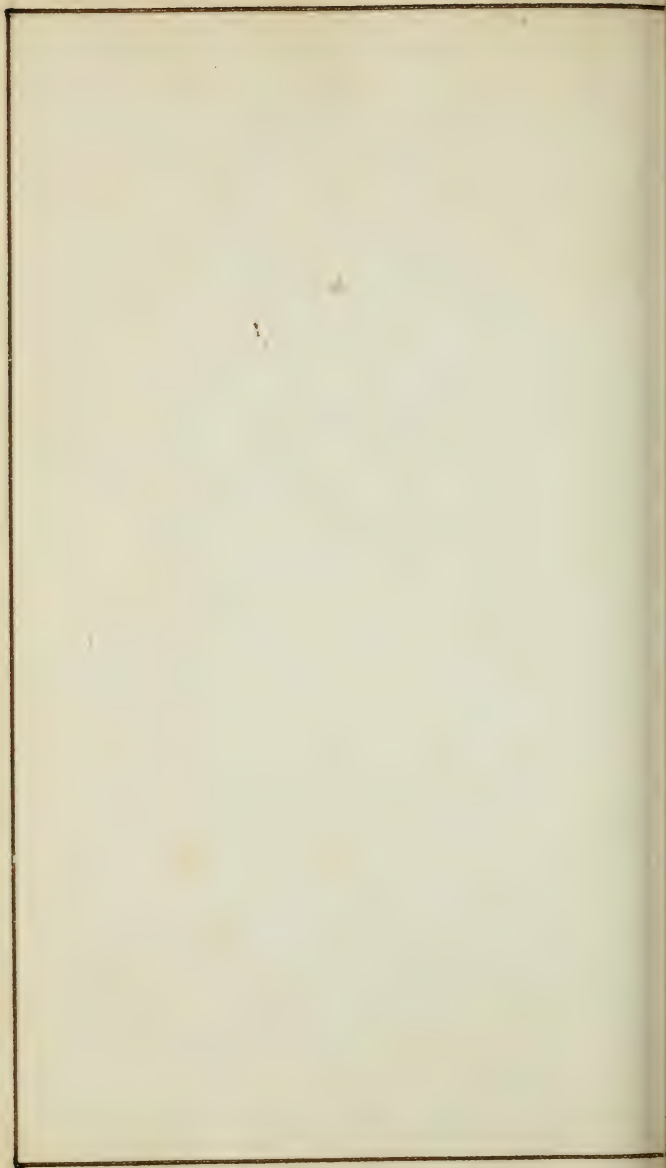


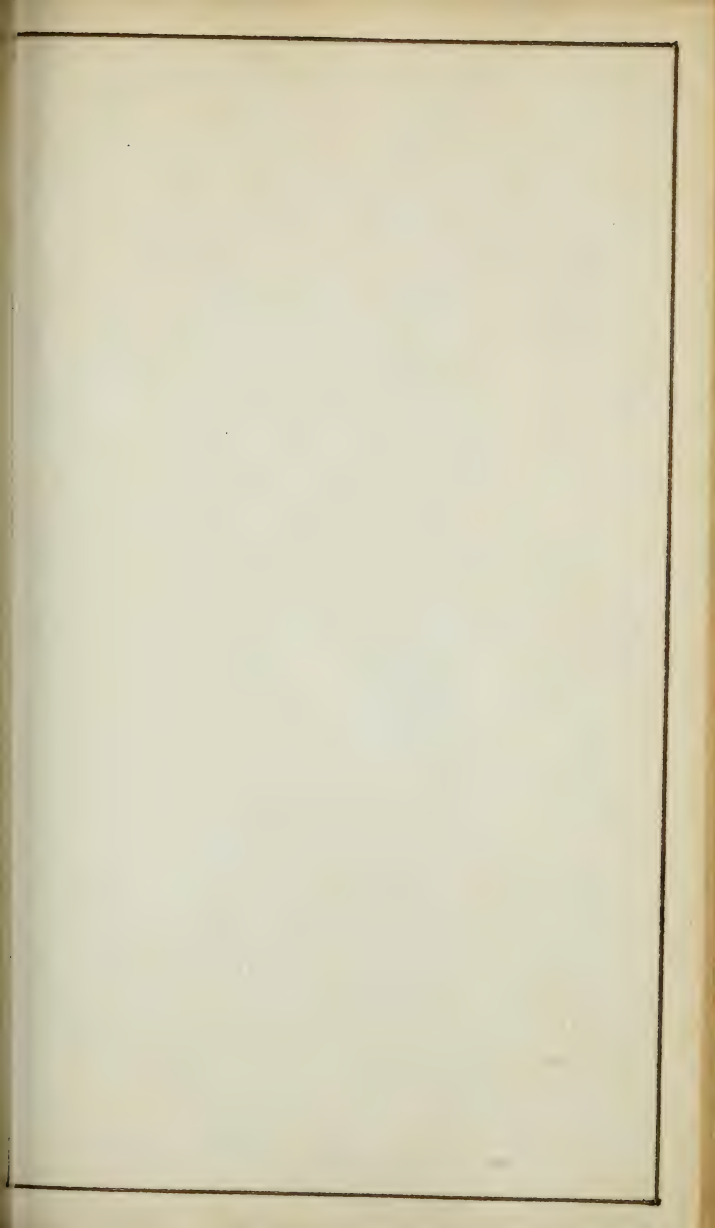


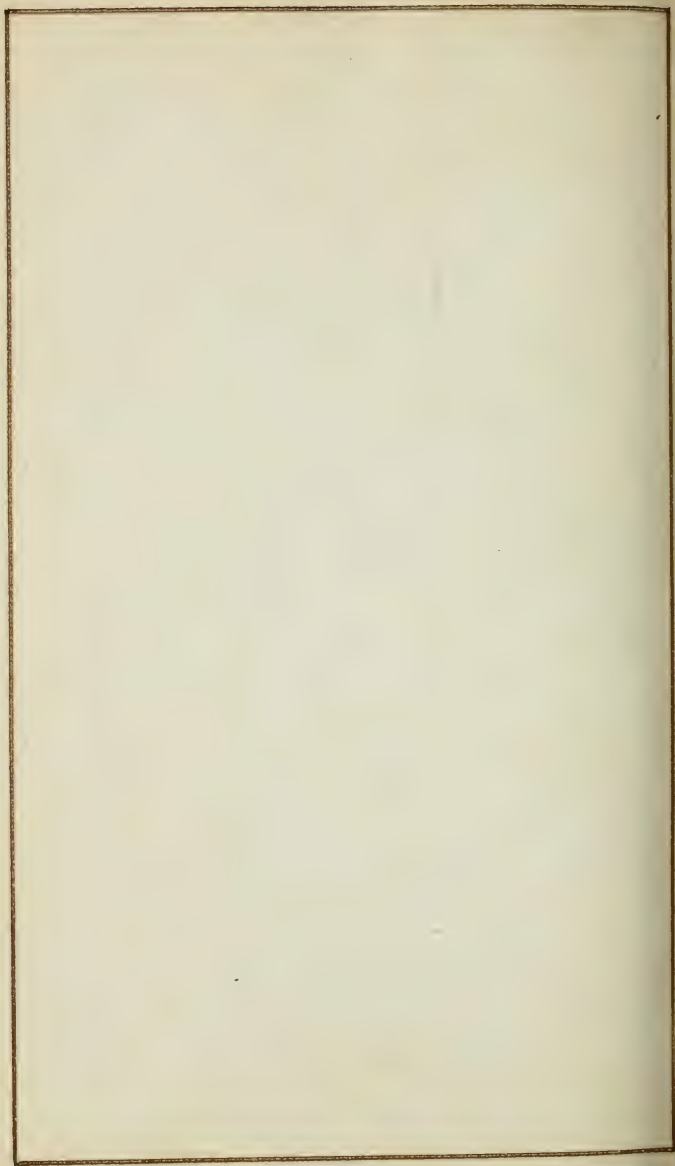


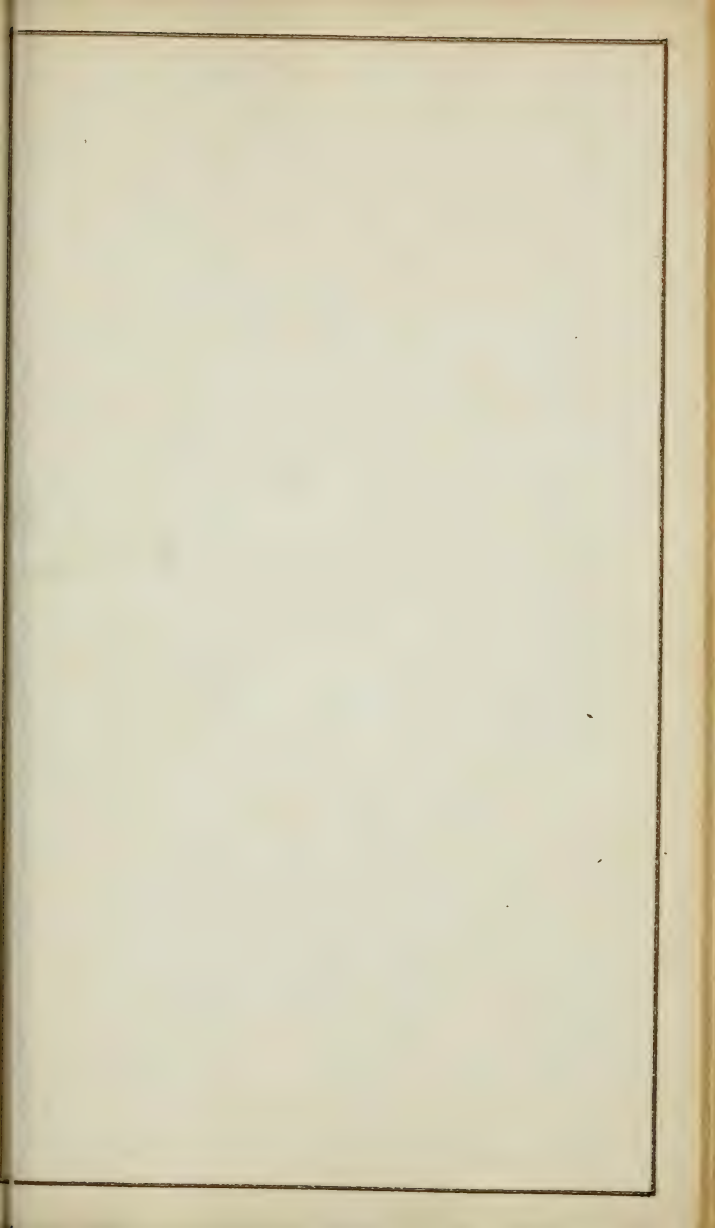


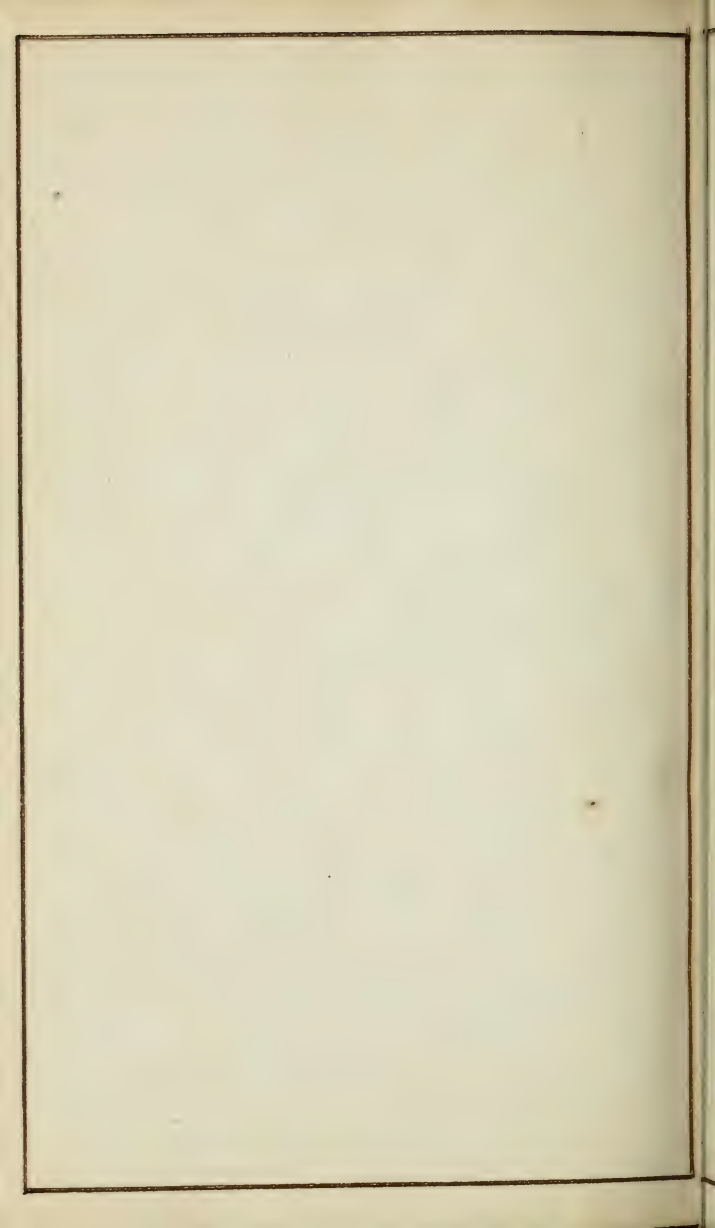


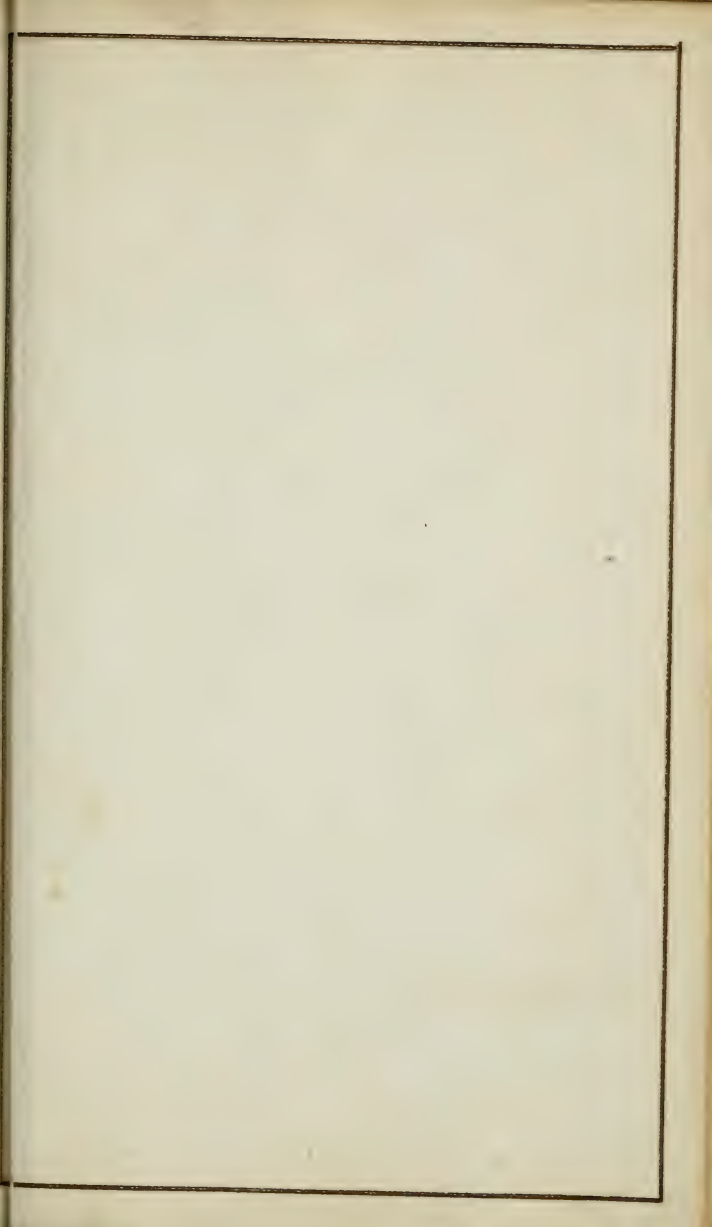


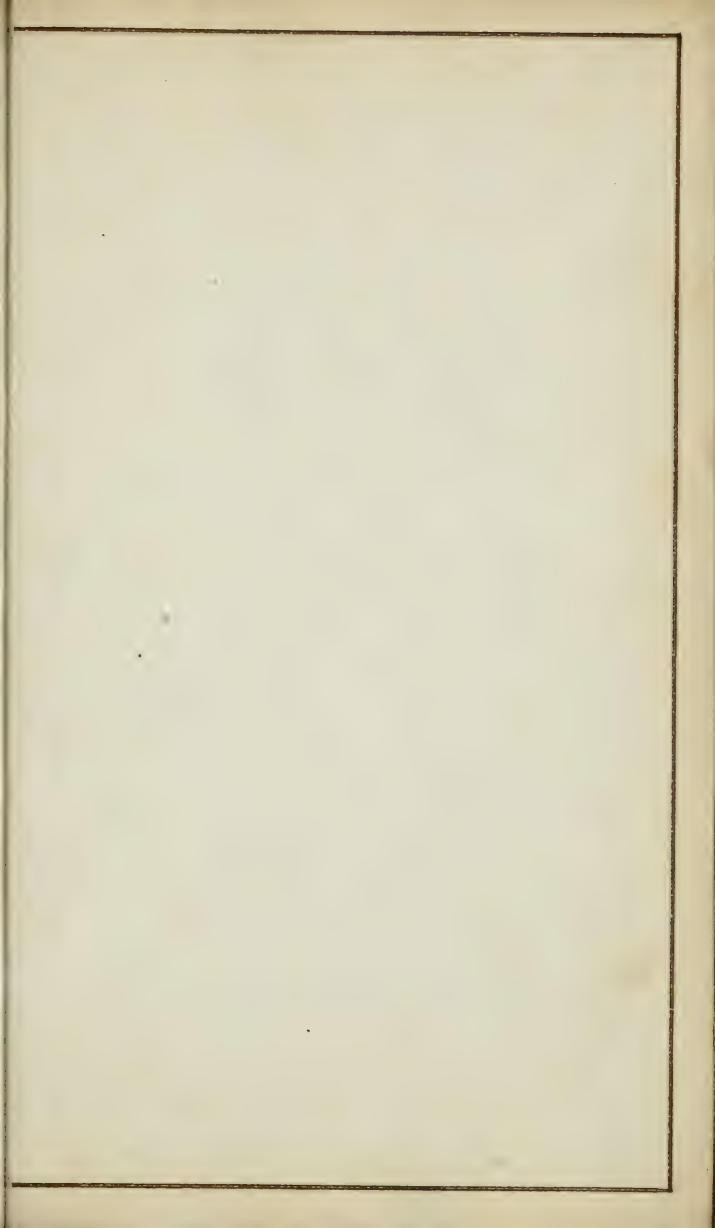












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